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STAR

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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US ISSN 0036-8741

Volume 29 Number 13 / July 8, 1991

TABLE OF CONTENTS

AERONAUTICS For related information see also *Astronautics.*

01 AERONAUTICS (GENERAL) ..... **N.A.**

02 AERODYNAMICS **2011**
Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery. For related information see also *34 Fluid Mechanics and Heat Transfer.*

03 AIR TRANSPORTATION AND SAFETY **2022**
Includes passenger and cargo air transport operations; and aircraft accidents. For related information see also *16 Space Transportation* and *85 Urban Technology and Transportation.*

04 AIRCRAFT COMMUNICATIONS AND NAVIGATION **2022**
Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control. For related information see also *17 Space Communications, Spacecraft Communications, Command and Tracking* and *32 Communications and Radar.*

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE **2023**
Includes aircraft simulation technology. For related information see also *18 Spacecraft Design, Testing and Performance* and *39 Structural Mechanics.* For land transportation vehicles see *85 Urban Technology and Transportation.*

06 AIRCRAFT INSTRUMENTATION **2024**
Includes cockpit and cabin display devices; and flight instruments. For related information see also *19 Spacecraft Instrumentation* and *35 Instrumentation and Photography.*

07 AIRCRAFT PROPULSION AND POWER **2025**
Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxiliary power plants for aircraft. For related information see also *20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *44 Energy Production and Conversion.*

08 AIRCRAFT STABILITY AND CONTROL **2026**
Includes aircraft handling qualities; piloting; flight controls; and autopilots. For related information see also *05 Aircraft Design, Testing and Performance.*

09 RESEARCH AND SUPPORT FACILITIES (AIR) **2028**
Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tubes; and aircraft engine test stands. For related information see also *14 Ground Support Systems and Facilities (Space).*

ASTRONAUTICS For related information see also *Aeronautics.*

12 ASTRONAUTICS (GENERAL) **2029**
For extraterrestrial exploration see *91 Lunar and Planetary Exploration.*

13 ASTRODYNAMICS **2031**
Includes powered and free-flight trajectories; and orbital and launching dynamics.

14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE) **2031**
Includes launch complexes, research and production facilities; ground support equipment, e.g., mobile transporters; and simulators. For related information see also *09 Research and Support Facilities (Air).*

15 LAUNCH VEHICLES AND SPACE VEHICLES **2032**
Includes boosters; operating problems of launch/space vehicle systems; and reusable vehicles. For related information see also *20 Spacecraft Propulsion and Power.*

16 SPACE TRANSPORTATION **2033**
Includes passenger and cargo space transportation, e.g., shuttle operations; and space rescue techniques. For related information see also *03 Air Transportation and Safety* and *18 Spacecraft Design, Testing and Performance.* For space suits see *54 Man/System Technology and Life Support.*

17 SPACE COMMUNICATIONS, SPACECRAFT COMMUNICATIONS, COMMAND AND TRACKING . **2034**
Includes telemetry; space communications networks; astronavigation and guidance; and radio blackout. For related information see also *04 Aircraft Communications and Navigation* and *32 Communications and Radar.*

N.A.—no abstracts were assigned to this category for this issue.

18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE **2034**
Includes satellites; space platforms; space stations; spacecraft systems and components such as thermal and environmental controls; and attitude controls. For life support systems see *54 Man/System Technology and Life Support.* For related information see also *05 Aircraft Design, Testing and Performance, 39 Structural Mechanics,* and *16 Space Transportation.*

19 SPACECRAFT INSTRUMENTATION ..... **N.A.**
For related information see also *06 Aircraft Instrumentation* and *35 Instrumentation and Photography.*

20 SPACECRAFT PROPULSION AND POWER **2042**
Includes main propulsion systems and components, e.g., rocket engines; and spacecraft auxiliary power sources. For related information see also *07 Aircraft Propulsion and Power, 28 Propellants and Fuels, 44 Energy Production and Conversion,* and *15 Launch Vehicles and Space Vehicles.*

CHEMISTRY AND MATERIALS

23 CHEMISTRY AND MATERIALS (GENERAL) ..... **N.A.**

24 COMPOSITE MATERIALS **2044**
Includes physical, chemical, and mechanical properties of laminates and other composite materials. For ceramic materials see *27 Nonmetallic Materials.*

25 INORGANIC AND PHYSICAL CHEMISTRY **2047**
Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry. For related information see also *77 Thermodynamics and Statistical Physics.*

26 METALLIC MATERIALS **2051**
Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

27 NONMETALLIC MATERIALS **2054**
Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials. For composite materials see *24 Composite Materials.*

28 PROPELLANTS AND FUELS **2057**
Includes rocket propellants, igniters and oxidizers; their storage and handling procedures; and aircraft fuels. For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *44 Energy Production and Conversion.*

29 MATERIALS PROCESSING **2059**
Includes space-based development of products and processes for commercial application. For biological materials see *55 Space Biology.*

ENGINEERING For related information see also *Physics.*

31 ENGINEERING (GENERAL) **2066**
Includes vacuum technology; control engineering; display engineering; cryogenics; and fire prevention.

32 COMMUNICATIONS AND RADAR **2069**
Includes radar; land and global communications; communications theory; and optical communications. For related information see also *04 Aircraft Communications and Navigation* and *17 Space Communications, Spacecraft Communications, Command and Tracking.* For search and rescue see *03 Air Transportation and Safety,* and *16 Space Transportation.*

33 ELECTRONICS AND ELECTRICAL ENGINEERING **2074**
Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry. For related information see also *60 Computer Operations and Hardware* and *76 Solid-State Physics.*

34 FLUID MECHANICS AND HEAT TRANSFER **2078**
Includes boundary layers; hydrodynamics; fluidics; mass transfer and ablation cooling. For related information see also *02 Aerodynamics* and *77 Thermodynamics and Statistical Physics.*

35 INSTRUMENTATION AND PHOTOGRAPHY **2087**
Includes remote sensors; measuring instruments and gauges; detectors; cameras and photographic supplies; and holography. For aerial photography see *43 Earth Resources and Remote Sensing.* For related information see also *06 Aircraft Instrumentation* and *19 Spacecraft Instrumentation.*

36 LASERS AND MASERS **2090**
Includes parametric amplifiers. For related information see also *76 Solid-State Physics.*

37 MECHANICAL ENGINEERING **2093**
Includes auxiliary systems (nonpower); machine elements and processes; and mechanical equipment.

38 QUALITY ASSURANCE AND RELIABILITY **2099**
Includes product sampling procedures and techniques; and quality control.

39 STRUCTURAL MECHANICS **2099**
Includes structural element design and weight analysis; fatigue; and thermal stress. For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance.*

GEOSCIENCES For related information see also *Space Sciences.*

42 GEOSCIENCES (GENERAL) **2105**

43 EARTH RESOURCES AND REMOTE SENSING **2107**
Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography. For instrumentation see *35 Instrumentation and Photography.*

44 ENERGY PRODUCTION AND CONVERSION **2112**
Includes specific energy conversion systems, e.g., fuel cells; global sources of energy; geophysical conversion; and windpower. For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *28 Propellants and Fuels.*

45 ENVIRONMENT POLLUTION **2112**
Includes atmospheric, noise, thermal, and water pollution.

46 GEOPHYSICS **2114**
Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism. For space radiation see *93 Space Radiation.*

47 METEOROLOGY AND CLIMATOLOGY **2119**
Includes weather forecasting and modification.

48 OCEANOGRAPHY **2123**
Includes biological, dynamic, and physical oceanography; and marine resources. For related information see also *43 Earth Resources and Remote Sensing.*

LIFE SCIENCES

51 LIFE SCIENCES (GENERAL) **2125**

52 AEROSPACE MEDICINE **2126**
Includes physiological factors; biological effects of radiation; and effects of weightlessness on man and animals.

53 BEHAVIORAL SCIENCES **2128**
Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT **2128**
Includes human engineering; biotechnology; and space suits and protective clothing. For related information see also *16 Space Transportation.*

55 SPACE BIOLOGY ..... **N.A.**
Includes exobiology; planetary biology; and extraterrestrial life.

MATHEMATICAL AND COMPUTER SCIENCES

59 MATHEMATICAL AND COMPUTER SCIENCES (GENERAL) ..... **N.A.**

60 COMPUTER OPERATIONS AND HARDWARE **2130**
Includes hardware for computer graphics, firmware, and data processing. For components see *33 Electronics and Electrical Engineering.*

61 COMPUTER PROGRAMMING AND SOFTWARE **2131**
Includes computer programs, routines, algorithms, and specific applications, e.g., CAD/CAM.

62 COMPUTER SYSTEMS **2138**
Includes computer networks and special application computer systems.

63 CYBERNETICS **2139**
Includes feedback and control theory, artificial intelligence, robotics and expert systems. For related information see also *54 Man/System Technology and Life Support.*

64 NUMERICAL ANALYSIS **2142**
Includes iteration, difference equations, and numerical approximation.

65 STATISTICS AND PROBABILITY **2144**
Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

66 SYSTEMS ANALYSIS **2145**
Includes mathematical modeling; network analysis; and operations research.

67 THEORETICAL MATHEMATICS **2146**
Includes topology and number theory.

PHYSICS For related information see also *Engineering.*

70 PHYSICS (GENERAL) **2146**
For precision time and time interval (PTTI) see *35 Instrumentation and Photography;* for geophysics, astrophysics or solar physics see *46 Geophysics, 90 Astrophysics,* or *92 Solar Physics.*

71 ACOUSTICS **2147**
Includes sound generation, transmission, and attenuation. For noise pollution see *45 Environment Pollution.*

72 ATOMIC AND MOLECULAR PHYSICS **2149**
Includes atomic structure, electron properties, and molecular spectra.

73 NUCLEAR AND HIGH-ENERGY PHYSICS **2152**
Includes elementary and nuclear particles; and reactor theory. For space radiation see *93 Space Radiation.*

74 OPTICS **2153**
Includes light phenomena and optical devices. For lasers see *36 Lasers and Masers.*

75 PLASMA PHYSICS **2155**
Includes magnetohydrodynamics and plasma fusion. For ionospheric plasmas see *46 Geophysics.* For space plasmas see *90 Astrophysics.*

76 SOLID-STATE PHYSICS **2159**
Includes superconductivity. For related information see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers.*

77 THERMODYNAMICS AND STATISTICAL PHYSICS **2164**
Includes quantum mechanics; theoretical physics; and Bose and Fermi statistics. For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

SOCIAL SCIENCES

80 SOCIAL SCIENCES (GENERAL) ..... **N.A.**
Includes educational matters.

81 ADMINISTRATION AND MANAGEMENT **2164**
Includes management planning and research.

82 DOCUMENTATION AND INFORMATION SCIENCE **2165**
Includes information management; information storage and retrieval technology; technical writing; graphic arts; and micrography. For computer documentation see *61 Computer Programming and Software.*

83 ECONOMICS AND COST ANALYSIS **2170**
Includes cost effectiveness studies.

84 LAW, POLITICAL SCIENCE AND SPACE POLICY **2170**
Includes NASA appropriation hearings; aviation law; space law and policy; international law; international cooperation; and patent policy.

85 URBAN TECHNOLOGY AND TRANSPORTATION **2171**
Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation. For related information see *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

SPACE SCIENCES For related information see also *Geosciences.*

88 SPACE SCIENCES (GENERAL) ..... **N.A.**

89 ASTRONOMY **2172**
Includes radio, gamma-ray, and infrared astronomy; and astrometry.

90 ASTROPHYSICS **2181**
Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust. For related information see also *75 Plasma Physics.*

91 LUNAR AND PLANETARY EXPLORATION **2182**
Includes planetology; and manned and unmanned flights. For spacecraft design or space stations see *18 Spacecraft Design, Testing and Performance.*

92 SOLAR PHYSICS **2183**
Includes solar activity, solar flares, solar radiation and sunspots. For related information see *93 Space Radiation.*

93 SPACE RADIATION **2183**
Includes cosmic radiation; and inner and outer earth's radiation belts. For biological effects of radiation see *52 Aerospace Medicine.* For theory see *73 Nuclear and High-Energy Physics.*

GENERAL

Includes aeronautical, astronautical, and space science related histories, biographies, and pertinent reports too broad for categorization; histories or broad overviews of NASA programs.

99 GENERAL **2184**

SUBJECT INDEX **I-1**

PERSONAL AUTHOR INDEX **I-71**

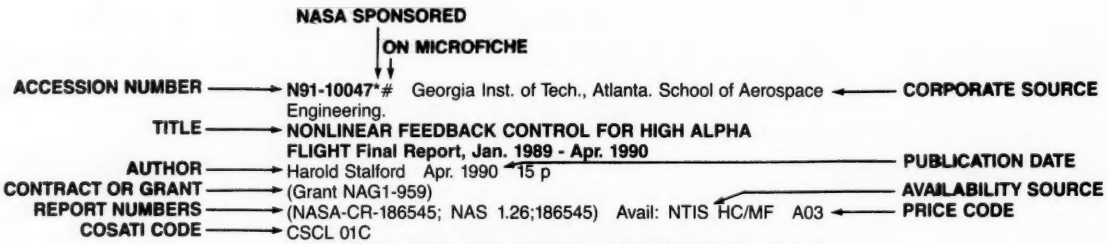
CORPORATE SOURCE INDEX **I-81**

CONTRACT NUMBER INDEX **I-95**

REPORT/ACCESSION NUMBER INDEX **I-99**

APPENDIX **A-1**

TYPICAL CITATION AND ABSTRACT



Analytical aerodynamic models are derived from a high alpha 6 DOF wind tunnel model. One detail model requires some interpolation between nonlinear functions of alpha. One analytical model requires no interpolation and as such is a completely continuous model. Flight path optimization is conducted on the basic maneuvers: half-loop, 90 degree pitch-up, and level turn. The optimal control analysis uses the derived analytical model in the equations of motion and is based on both moment and force equations. The maximum principle solution for the half-loop is poststall trajectory performing the half-loop in 13.6 seconds. The agility induced by thrust vectoring capability provided a minimum effect on reducing the maneuver time. By means of thrust vectoring control the 90 degrees pitch-up maneuver can be executed in a small place over a short time interval. The agility capability of thrust vectoring is quite beneficial for pitch-up maneuvers. The level turn results are based currently on only outer layer solutions of singular pertrubation. Poststall solutions provide high turn rates but generate higher losses of energy than that of classical sustained solutions.

Author

VOLUME 29 NUMBER 13 / JULY 8, 1991

Scientific and Technical Aerospace Reports

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01 AERONAUTICS (GENERAL)

No abstracts in this category.

02 AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

For related information see also *34 Fluid Mechanics and Heat Transfer.*

N91-21059*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

STATIC THRUST-VECTORING PERFORMANCE OF NONAXISYMMETRIC CONVERGENT-DIVERGENT NOZZLES WITH POST-EXIT YAW VANES M.S. Thesis - George Washington Univ., Aug. 1988

Robert J. Foley (George Washington Univ., Washington, DC.) and Odis C. Pendergraft, Jr. May 1991 81 p

(NASA-TP-3085; L-16784; NAS 1.60:3085) Avail: NTIS HC/MF A05 CSCL 01A

A static (wind-off) test was conducted in the Static Test Facility of the 16-ft transonic tunnel to determine the performance and turning effectiveness of post-exit yaw vanes installed on two-dimensional convergent-divergent nozzles. One nozzle design that was previously tested was used as a baseline, simulating dry power and afterburning power nozzles at both 0 and 20 degree pitch vectoring conditions. Vanes were installed on these four nozzle configurations to study the effects of vane deflection angle, longitudinal and lateral location, size, and camber. All vanes were hinged at the nozzle sidewall exit, and in addition, some were also hinged at the vane quarter chord (double-hinged). The vane concepts tested generally produced yaw thrust vectoring angles much less than the geometric vane angles, for (up to 8 percent) resultant thrust losses. When the nozzles were pitch vectored, yawing effectiveness decreased as the vanes were moved downstream. Thrust penalties and yawing effectiveness both decreased rapidly as the vanes were moved outboard (laterally). Vane length and height changes increased yawing effectiveness and thrust ratio losses, while using vane camber, and double-hinged vanes increased resultant yaw angles by 50 to 100 percent.

Author

N91-21060*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

COMPRESSIBLE FLOWS WITH PERIODIC VORTICAL DISTURBANCES AROUND LIFTING AIRFOILS Ph.D. Thesis - Notre Dame Univ.

James R. Scott Jan. 1991 214 p

(NASA-TM-103742; E-5984; NAS 1.15:103742) Avail: NTIS HC/MF A10 CSCL 01A

A numerical method is developed for solving periodic, three-dimensional, vortical flows around lifting airfoils in subsonic flow. The first-order method that is presented fully accounts for the distortion effects of the nonuniform mean flow on the convected upstream vortical disturbances. The unsteady velocity is split into a vortical component which is a known function of the upstream flow conditions and the Lagrangian coordinates of the mean flow, and an irrotational field whose potential satisfies a non-constant-coefficient, inhomogeneous, convective wave equation. Using an elliptic coordinate transformation, the unsteady boundary value problem is solved in the frequency domain on grids which are determined as a function of the Mach number and reduced frequency. The numerical scheme is validated through extensive comparisons with known solutions to unsteady vortical flow problems. In general, it is seen that the agreement between the numerical and analytical results is very good for reduced frequencies ranging from 0 to 4, and for Mach numbers ranging from .1 to .8. Numerical results are also presented for a wide variety of flow configurations for the purpose of determining the effects of airfoil thickness, angle of attack, camber, and Mach number on the unsteady lift and moment of airfoils subjected to periodic vortical gusts. It is seen that each of these parameters can have a significant effect on the unsteady airfoil response to the incident disturbances, and that the effect depends strongly upon the reduced frequency and the dimensionality of the gust. For a one-dimensional (transverse) or two-dimensional (transverse and longitudinal) gust, the results indicate that airfoil thickness increases the unsteady lift and moment at the low reduced frequencies but decreases it at the high reduced frequencies. The results show that an increase in airfoil Mach number leads to a significant increase in the unsteady lift and moment for the low reduced frequencies, but a significant decrease for the high reduced frequencies.

Author

N91-21061*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

EXPERIMENTAL STUDY OF BOUNDARY LAYER TRANSITION ON A HEATED FLAT PLATE

K. H. Sohn, E. Reshotko (Case Western Reserve Univ., Cleveland, OH.), and K. B. M. Q. Zaman 1991 17 p Prepared for presentation at the 1991 Joint ASME-JSME Fluids Engineering Conference, Portland, OR, 24-26 Jun. 1991

(Grant NAG3-230)

(NASA-TM-103779; E-6050; NAS 1.15:103779) Avail: NTIS HC/MF A03 CSCL 01A

A detailed investigation to the document momentum and thermal development of boundary layers undergoing natural transition on a heated flat plate was performed. Experimental results of both overall and conditionally sampled characteristics of laminar, transitional, and low Reynolds number turbulent boundary layers are presented. Measurements were done in a low-speed, closed-loop wind tunnel with a freestream velocity of 100 ft/s and zero pressure gradient over a range of freestream turbulence intensities from 0.4 to 6 percent. The distributions of skin friction, heat transfer rate, and Reynolds shear stress were all consistent with previously published data. Reynolds analogy factors for momentum thickness Reynolds number, Re(sub theta) less than 2300 were found to be well predicted by laminar and turbulent correlations which accounted for an unheated starting length and uniform heat flux. A small dependence of turbulence results on the freestream turbulence intensity was observed.

Author

N91-21062*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
COMPUTATIONAL FLUID DYNAMICS SYMPOSIUM ON AEROPROPULSION
Washington Jan. 1991 687 p Symposium held in Cleveland, OH, 24-26 Apr. 1990 Supersedes NASA-CP-10045 Original contains color illustrations
(NASA-CP-3078; E-5296; NASA-CP-10045; NAS 1.55:3078)
Avail: NTIS HC/MF A99; 10 functional color pages CSCL 01A

Recognizing the considerable advances that have been made in computational fluid dynamics, the Internal Fluid Mechanics Division of NASA Lewis Research Center sponsored this symposium with the objective of providing a forum for exchanging information regarding recent developments in numerical methods, physical and chemical modeling, and applications. This conference publication is a compilation of 4 invited and 34 contributed papers presented in six sessions: algorithms one and two, turbomachinery, turbulence, components application, and combustors. Topics include numerical methods, grid generation, chemically reacting flows, turbulence modeling, inlets, nozzles, and unsteady flows. For individual titles, see N91-21063 through N91-21098.

N91-21063*# California Univ., Davis. Dept. of Mechanical, Aeronautical, and Materials Engineering.
THOUGHTS ON THE CHIMERA METHOD OF SIMULATION OF THREE-DIMENSIONAL VISCOUS FLOW **c34**
Joseph L. Steger *In* NASA, Lewis Research Center, Computational Fluid Dynamics Symposium on Aeropropulsion Jan. 1991 p 1-10 (For primary document see N91-21062 13-02)
Avail: NTIS HC/MF A99; 10 functional color pages CSCL 20D

The chimera overset grid is reviewed and discussed relative to other procedures for simulating flow about complex configurations. It is argued that while more refinement of the technique is needed, current schemes are competitive to unstructured grid schemes and should ultimately prove more useful. Author

N91-21064*# Massachusetts Inst. of Tech., Cambridge.
GENERATION AND USE OF UNSTRUCTURED GRIDS FOR TURBOMACHINERY CALCULATIONS **c61**
Dana R. Lindquist and Michael B. Giles *In* NASA, Lewis Research Center, Computational Fluid Dynamics Symposium on Aeropropulsion Jan. 1991 p 11-27 Original contains color illustrations (For primary document see N91-21062 13-02)
Avail: NTIS HC/MF A99; 10 functional color pages CSCL 09B

A wavefront mesh generator for two dimensional triangular meshes as well as a brief description of the solution method used with these meshes are presented. The interest is in creating meshes for solving the equations of fluid mechanics in complex turbomachinery problems, although the mesh generator and flow solver may be used for a larger variety of applications. The focus is on the flexibility and power of the mesh generation method for triangulating extremely complex geometries and in changing the geometry to create a new mesh. Two turbomachinery applications are presented which take advantage of this method: the analysis of pylon/strut and pylon/OGV interaction in the bypass of a turbofan. Author

N91-21065*# Rockwell International Science Center, Thousand Oaks, CA.
UNSTRUCTURED GRID GENERATION USING THE DISTANCE FUNCTION **c61**
Barna L. Bihari and Sukumar R. Chakravarthy *In* NASA, Lewis Research Center, Computational Fluid Dynamics Symposium on Aeropropulsion Jan. 1991 p 29-40 (For primary document see N91-21062 13-02)
Avail: NTIS HC/MF A99; 10 functional color pages CSCL 09B

A new class of methods for obtaining level sets to generate unstructured grids is presented. The consecutive grid levels are computed using the distance functions, which corresponds to solving the Hamilton-Jacobi equations representing the equations of motion of fronts propagating with curvature-dependent speed. The relationship between the distance function and the governing equations will be discussed as well as its application to generating grids. Multi-ply connected domains and complex geometries are handled naturally, with a straightforward generalization to several space dimensions. The grid points for the unstructured grid are obtained simultaneously with the grid levels. The search involved in checking for overlapping triangles is minimized by triangulating the entire domain one level at a time. Author

N91-21066*# Massachusetts Inst. of Tech., Cambridge.
COMPUTATIONAL STUDY OF THREE DIMENSIONAL VISCOUS FLOW THROUGH A TURBINE CASCADE USING A MULTI-DOMAIN SPECTRAL TECHNIQUE **c34**
Earl W. Renaud and Choon S. Tan *In* NASA, Lewis Research Center, Computational Fluid Dynamics Symposium on Aeropropulsion Jan. 1991 p 41-53 (For primary document see N91-21062 13-02)
(Grants NAG3-660; AF-AFOSR-0288-85)
Avail: NTIS HC/MF A99; 10 functional color pages CSCL 20D

The three dimensional viscous flow through a planar turbine cascade is numerically simulated by direct solution of the incompressible Navier-Stokes equations. Flow dependence in the spanwise direction is represented by direct expansion in Chebyshev polynomials, while the discretization on planes parallel to the endwalls is accomplished using the spectral element method. Elemental mapping from the physical to the computational space uses an algebraic mapping technique. A fractional time stepping method that consists of an explicit nonlinear convective step, an implicit pressure correction step, and an implicit viscous step is used to advance the Navier-Stokes equations forward in time. Results computed at moderate Reynolds numbers show a three dimensional endwall flow separation, a midspan separation of the blade suction surface boundary layer, and other three-dimensional features such as the presence of a saddle point flow in the endwall region. In addition, the computed skin friction lines are shown to be orthogonal to the surface vorticity lines, demonstrating the accuracy achievable in the present method. Author

N91-21067*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
A FINITE-DIFFERENCE, FREQUENCY-DOMAIN NUMERICAL SCHEME FOR THE SOLUTION OF THE LINEARIZED UNSTEADY EULER EQUATIONS **c34**
James R. Scott and Hafiz M. Atassi (Notre Dame Univ., IN.) *In its* Computational Fluid Dynamics Symposium on Aeropropulsion Jan. 1991 p 55-104 (For primary document see N91-21062 13-02)
Avail: NTIS HC/MF A99; 10 functional color pages CSCL 20D

A numerical method is developed for solving periodic, three-dimensional, vortical flows around lifting airfoils in subsonic flow conditions and the Lagrangian coordinates of the mean flow, and an irrotational field whose potential satisfies a non-constant-coefficient, inhomogeneous, convective wave equation. Using an elliptic coordinate transformation, the unsteady flow conditions and the Lagrangian coordinates of the mean flow, and an irrotational field whose potential satisfies a nonconstant-coefficient, inhomogeneous, convective wave equation. Using an elliptic coordinate transformation, the unsteady boundary value problem is solved in the frequency domain on grids which are determined as a function of the Mach number and reduced frequency. Extensive comparisons are made with known solutions to unsteady vortical flow problems, and it is seen that the agreement is generally very good for reduced frequencies ranging from 0 up to 4. Author

N91-21068*# Cincinnati Univ., OH.
A PRESSURE FLUX-SPLIT TECHNIQUE FOR COMPUTATION OF INLET FLOW BEHAVIOR **c34**
H. S. Pordal, P. K. Khosla, and S. G. Rubin *In* NASA, Lewis Research Center, Computational Fluid Dynamics Symposium on Aeropropulsion Jan. 1991 p 105-117 (For primary document see N91-21062 13-02)
(Contract NAG3-716; F49620-85-C-0027)
Avail: NTIS HC/MF A99; 10 functional color pages CSCL 20D

A method for calculating the flow field in aircraft engine inlets

is presented. The phenomena of inlet unstart and restart are investigated. Solutions of the reduced Navier-Stokes (RNS) equations are obtained with a time consistent direct sparse matrix solver that computes the transient flow field both internal and external to the inlet. Time varying shocks and time varying recirculation regions can be efficiently analyzed. The code is quite general and is suitable for the computation of flow for a wide variety of geometries and over a wide range of Mach and Reynolds numbers. Author

N91-21069*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
SIMULATION OF TURBOMACHINERY FLOWS **c34**
John J. Adamczyk *In its* Computational Fluid Dynamics Symposium on Aeropropulsion Jan. 1991 p 119-126 (For primary document see N91-21062 13-02)
Avail: NTIS HC/MF A99; 10 functional color pages CSCL 20D

With the interest in jet propulsion at the end of World War II, aerodynamicists were challenged to develop mathematical models which could be used to design turbomachinery components for jets. NASA Lewis engineers and scientists played a major role in meeting this challenge. Some of their accomplishments are highlighted as well as those of others. Several problems are addressed which must be solved if jet propulsion technology is to advance. Author

N91-21070*# Rockwell International Corp., Canoga Park, CA. Rocketdyne Div.
NUMERICAL SOLUTIONS OF 2-D MULTI-STAGE ROTOR/STATOR UNSTEADY FLOW INTERACTIONS **c34**
R.-J. Yang and S.-J. Lin *In* NASA, Lewis Research Center, Computational Fluid Dynamics Symposium on Aeropropulsion Jan. 1991 p 127-142 Original contains color illustrations (For primary document see N91-21062 13-02)
(Contract NAS8-40000)
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The Rai method of single-stage rotor/stator flow interaction is extended to handle multistage configurations. In this study, a two-dimensional Navier-Stokes multi-zone approach was used to investigate unsteady flow interactions within two multistage axial turbines. The governing equations are solved by an iterative, factored, implicit finite-difference, upwind algorithm. Numerical accuracy is checked by investigating the effect of time step size, the effect of subiteration in the Newton-Raphson technique, and the effect of full viscous versus thin-layer approximation. Computer results compared well with experimental data. Unsteady flow interactions, wake cutting, and the associated evolution of vortical entities are discussed. Author

N91-21071*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
TRANSONIC CASCADE FLOW CALCULATIONS USING NON-PERIODIC C-TYPE GRIDS **c34**
Andrea Arnone, Meng-Sing Liou, and Louis A. Povinelli *In its* Computational Fluid Dynamics Symposium on Aeropropulsion Jan. 1991 p 143-162 (For primary document see N91-21062 13-02)
(NASA Order C-99066-G)
Avail: NTIS HC/MF A99; 10 functional color pages CSCL 20D

A new kind of C-type grid is proposed for turbomachinery flow calculations. This grid is nonperiodic on the wake and results in minimum skewness for cascades with high turning and large camber. Euler and Reynolds averaged Navier-Stokes equations are discretized on this type of grid using a finite volume approach. The Baldwin-Lomax eddy-viscosity model is used for turbulence closure. Jameson's explicit Runge-Kutta scheme is adopted for the integration in time, and computational efficiency is achieved through accelerating strategies such as multigriding and residual smoothing. A detailed numerical study was performed for a turbine rotor and for a vane. A grid dependence analysis is presented and the effect of artificial dissipation is also investigated. Comparison of calculations with experiments clearly demonstrates the advantage of the proposed grid. Author

N91-21072*# Pennsylvania State Univ., University Park. Dept. of Aerospace Engineering.
COMPUTATION OF SUPERSONIC AND LOW SUBSONIC CASCADE FLOWS USING AN EXPLICIT NAVIER-STOKES TECHNIQUE AND THE KAPPA-EPSILON TURBULENCE MODEL **c34**
R. F. Kunz and B. Lakshminarayana *In* NASA, Lewis Research Center, Computational Fluid Dynamics Symposium on Aeropropulsion Jan. 1991 p 163-201 (For primary document see N91-21062 13-02)
(Contract DAAL03-86-G-0044)
Avail: NTIS HC/MF A99; 10 functional color pages CSCL 20D

A fully explicit two-dimensional flow solver, based on a four-stage Runge-Kutta scheme, was developed and utilized to predict two-dimensional viscous flow through turbomachinery cascades for which experimental data is available. The formulation is applied to the density averaged Navier-Stokes equations. Several features of the technique improve the ability of the code to predict high Reynolds number flows on highly stretched grids. These include a low Reynolds number compressible form of the k-epsilon turbulence model, anisotropic scaling of artificial dissipation terms and locally varying timestep evaluation based on hyperbolic and parabolic stability considerations. Comparisons between computation and experiment are presented for both a supersonic and a low-subsonic compressor cascade. These results indicate that the code is capable of predicting steady two-dimensional viscous cascade flows over a wide range of Mach numbers in reasonable computational times. Author

N91-21073*# Michigan Univ., Ann Arbor. Dept. of Aerospace Engineering.
FLUX-VECTOR SPLITTING FOR THE 1990S **c34**
Bram vanLeer *In* NASA, Lewis Research Center, Computational Fluid Dynamics Symposium on Aeropropulsion Jan. 1991 p 203-214 (For primary document see N91-21062 13-02)
Avail: NTIS HC/MF A99; 10 functional color pages CSCL 20D

The development of flux-vector splitting through the 1970s and 1980s is reviewed. Attention is given to the diffusive nature of flux-vector splitting, which makes it an undesirable technique for approximating the inviscid fluxes in a Navier-Stokes solver. Several proposed improvements, including a brand new one, are discussed and illustrated by a simple, yet revealing, numerical test case. Finally, an outlook for flux-vector splitting in the 1990s is presented. Author

N91-21074*# Cleveland State Univ., OH. Dept. of Mathematics.
ON THE APPLICATION OF ENO SCHEME WITH SUBCELL RESOLUTION TO CONSERVATION LAWS WITH STIFF SOURCE TERMS **c34**
Shih-Hung Chang *In* NASA, Lewis Research Center, Computational Fluid Dynamics Symposium on Aeropropulsion Jan. 1991 p 215-225 (For primary document see N91-21062 13-02)
(NASA Order C-99066-G)
Avail: NTIS HC/MF A99; 10 functional color pages CSCL 20D

Two approaches are used to extend the essentially non-oscillatory (ENO) schemes to treat conservation laws with stiff source terms. One approach is the application of the Strang time-splitting method. Here the basic ENO scheme and the Harten modification using subcell resolution (SR), ENO/SR scheme, are extended this way. The other approach is a direct method and a modification of the ENO/SR. Here the technique of ENO reconstruction with subcell resolution is used to locate the discontinuity within a cell and the time evolution is then accomplished by solving the differential equation along characteristics locally and advancing in the characteristic direction. This scheme is denoted ENO/SRCD (subcell resolution - characteristic direction). All the schemes are tested on the equation of LeVeque and Yee (NASA-TM-100075, 1988) modeling reacting flow problems. Numerical results show that these schemes handle this intriguing model problem very well, especially with ENO/SRCD which produces perfect resolution at the discontinuity. Author

N91-21075*# Akron Univ., OH.
COST-EFFECTIVE ACCURATE COARSE-GRID METHOD FOR HIGHLY CONVECTIVE MULTIDIMENSIONAL UNSTEADY FLOWS **c34**
B. P. Leonard and H. S. Niknafs *In* NASA, Lewis Research Center, Computational Fluid Dynamics Symposium on Aeropropulsion Jan. 1991 p 227-240 (For primary document see N91-21062 13-02)
Avail: NTIS HC/MF A99; 10 functional color pages CSCL 20D

A fundamentally multidimensional convection scheme is described based on vector transient interpolation modeling rewritten in conservative control-volume form. Vector third-order upwinding is used as the basis of the algorithm; this automatically introduces important cross-difference terms that are absent from schemes using component-wise one-dimensional formulas. Third-order phase accuracy is good; this is important for coarse-grid large-eddy or full simulation. Potential overshoots or undershoots are avoided by using a recently developed universal limiter. Higher order accuracy is obtained locally, where needed, by the cost-effective strategy of adaptive stencil expansion in a direction normal to each control-volume face; this is controlled by monitoring the absolute normal gradient and curvature across the face. Higher (than third) order cross-terms do not appear to be needed. Since the wider stencil is used only in isolated narrow regions (near discontinuities), extremely high (in this case, seventh) order accuracy can be achieved for little more than the cost of a globally third-order scheme. Author

N91-21076*# Florida Univ., Gainesville. Dept. of Aerospace Engineering, Mechanics and Engineering Science.
CHOICE OF VELOCITY VARIABLES FOR COMPLEX FLOW COMPUTATION **c34**
W. Shyy and G. C. Chang (Chung Shan Inst. of Science and Technology, Taiwan) *In* NASA, Lewis Research Center, Computational Fluid Dynamics Symposium on Aeropropulsion Jan. 1991 p 241-257 (For primary document see N91-21062 13-02)
Avail: NTIS HC/MF A99; 10 functional color pages CSCL 20D

The issue of adopting the velocity components as dependent velocity variables for the Navier-Stokes flow computations is investigated. The viewpoint advocated is that a numerical algorithm should preferably honor both the physical conservation law in differential form and the geometric conservation law in discrete form. With the use of Cartesian velocity vector, the momentum equations in curvilinear coordinates can retain the full conservation-law form and satisfy the physical conservation laws. With the curvilinear velocity components, source terms appear in differential equations and hence the full conservation law form can not be retained. In discrete expressions, algorithms based on the Cartesian components can satisfy the geometric conservation-law form for convection terms but not for viscous terms; those based on the curvilinear components, on the other hand, cannot satisfy the geometric conservation-law form for either convection or viscous terms. Several flow solutions for domain with 90 and 360 degree turnings are presented to illustrate the issues of using the Cartesian velocity components and the staggered grid arrangement. Author

N91-21077*# Pennsylvania State Univ., University Park.
DISTRIBUTED MINIMAL RESIDUAL (DMR) METHOD FOR ACCELERATION OF ITERATIVE ALGORITHMS **c34**
Seungsoo Lee and George S. Dulikravich *In* NASA, Lewis Research Center, Computational Fluid Dynamics Symposium on Aeropropulsion Jan. 1991 p 259-280 (For primary document see N91-21062 13-02)
Avail: NTIS HC/MF A99; 10 functional color pages CSCL 20D

A new method for enhancing the convergence rate of iterative algorithms for the numerical integration of systems of partial differential equations was developed. It is termed the Distributed Minimal Residual (DMR) method and it is based on general Krylov subspace methods. The DMR method differs from the Krylov subspace methods by the fact that the iterative acceleration factors are different from equation to equation in the system. At the same time, the DMR method can be viewed as an incomplete Newton iteration method. The DMR method was applied to Euler equations of gas dynamics and incompressible Navier-Stokes equations. All numerical test cases were obtained using either explicit four stage Runge-Kutta or Euler implicit time integration. The formulation for the DMR method is general in nature and can be applied to explicit and implicit iterative algorithms for arbitrary systems of partial differential equations. Author

N91-21078*# Pennsylvania State Univ., University Park. Dept. of Aerospace Engineering.
A PRESSURE BASED METHOD FOR THE SOLUTION OF VISCOUS INCOMPRESSIBLE TURBOMACHINERY FLOWS **c34**
Garth Victor Hobson and B. Lakshminarayana *In* NASA, Lewis Research Center, Computational Fluid Dynamics Symposium on Aeropropulsion Jan. 1991 p 281-309 (For primary document see N91-21062 13-02)
(Grants NsG-3266; NAC-817)
Avail: NTIS HC/MF A99; 10 functional color pages CSCL 20D

A new technique was developed for the solution of the incompressible Navier-Stokes equations. The numerical technique, derived from a pressure substitution method (PSM), overcomes many of the deficiencies of the pressure correction method. This technique allows for the direct solution of the actual pressure in the form of a Poisson equation which is derived from the pressure weighted substitution of the full momentum equations into the continuity equation. Two dimensional internal flows are computed with this method. The prediction of cascade performance is presented. The extention of the pressure correction method for the solution of three dimensional flows is also presented. Author

N91-21079*# Advanced Projects Research, Inc., Moorpark, CA.
A MULTIDIMENSIONAL FINITE ELEMENT METHOD FOR CFD **c34**
Darrell W. Pepper and Joseph W. Humphrey *In* NASA, Lewis Research Center, Computational Fluid Dynamics Symposium on Aeropropulsion Jan. 1991 p 311-334 Original contains color illustrations (For primary document see N91-21062 13-02)
Avail: NTIS HC/MF A99; 10 functional color pages CSCL 20D

A finite element method is used to solve the equations of motion for 2- and 3-D fluid flow. The time-dependent equations are solved explicitly using quadrilateral (2-D) and hexahedral (3-D) elements, mass lumping, and reduced integration. A Petrov-Galerkin technique is applied to the advection terms. The method requires a minimum of computational storage, executes quickly, and is scalable for execution on computer systems ranging from PCs to supercomputers. Author

N91-21080*# Cornell Univ., Ithaca, NY.
THE PDF METHOD FOR TURBULENT COMBUSTION **c34**
S. B. Pope *In* NASA, Lewis Research Center, Computational Fluid Dynamics Symposium on Aeropropulsion Jan. 1991 p 335-346 (For primary document see N91-21062 13-02)
(Contract F33615-87-C-2821; NSF CBT-88-14655)
Avail: NTIS HC/MF A99; 10 functional color pages CSCL 20D

Probability Density Function (PDF) methods provide a means of calculating the properties of turbulent reacting flows. They have been successfully applied to many turbulent flames, including some with finite rate kinetic effects. Here the methods are reviewed with an emphasis on computational issues and their application to turbulent combustion. Author

N91-21081*# Detroit Diesel Allison, Indianapolis, IN.
PRESSURE ALGORITHM FOR ELLIPTIC FLOW CALCULATIONS WITH THE PDF METHOD **c34**
M. S. Anand, S. B. Pope (Cornell Univ., Ithaca, NY.), and H. C. Mongia *In* NASA, Lewis Research Center, Computational Fluid Dynamics Symposium on Aeropropulsion Jan. 1991 p 347-362 (For primary document see N91-21062 13-02)
(Contract F33615-87-C-2821)
Avail: NTIS HC/MF A99; 10 functional color pages CSCL 20D

An algorithm to determine the mean pressure field for elliptic

flow calculations with the probability density function (PDF) method is developed and applied. The PDF method is a most promising approach for the computation of turbulent reacting flows. Previous computations of elliptic flows with the method were in conjunction with conventional finite volume based calculations that provided the mean pressure field. The algorithm developed and described here permits the mean pressure field to be determined within the PDF calculations. The PDF method incorporating the pressure algorithm is applied to the flow past a backward-facing step. The results are in good agreement with data for the reattachment length, mean velocities, and turbulence quantities including triple correlations. Author

N91-21082*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
IMPLICIT SOLUTION OF THREE-DIMENSIONAL INTERNAL TURBULENT FLOWS c34
V. Michelassi, M.-S. Liou, Louis A. Povinelli, and F. Martelli (Florence Univ., Italy) *In its* Computational Fluid Dynamics Symposium on Aeropropulsion Jan. 1991 p 363-391 (For primary document see N91-21062 13-02)
(NASA Order C-99066-G)
Avail: NTIS HC/MF A99; 10 functional color pages CSCL 20D

The scalar form of the approximate factorization method was used to develop a new code for the solution of three dimensional internal laminar and turbulent compressible flows. The Navier-Stokes equations in their Reynolds-averaged form were iterated in time until a steady solution was reached. Evidence was given to the implicit and explicit artificial damping schemes that proved to be particularly efficient in speeding up convergence and enhancing the algorithm robustness. A conservative treatment of these terms at the domain boundaries was proposed in order to avoid undesired mass and/or momentum artificial fluxes. Turbulence effects were accounted for by the zero-equation Baldwin-Lomax turbulence model and the q-omega two-equation model. The flow in a developing S-duct was then solved in the laminar regime in a Reynolds number (Re) of 790 and in the turbulent regime at Re equals 40,000 by using the Baldwin-Lomax model. The Stanitz elbow was then solved by using an invicid version of the same code at M sub inlet equals 0.4. Grid dependence and convergence rate were investigated, showing that for this solver the implicit damping scheme may play a critical role for convergence characteristics. The same flow at Re equals 2.5 times 10(exp 6) was solved with the Baldwin-Lomax and the q-omega models. Both approaches show satisfactory agreement with experiments, although the q-omega model was slightly more accurate. Author

N91-21083*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
NUMERICAL INVESTIGATION OF AN INTERNAL LAYER IN TURBULENT FLOW OVER A CURVED HILL c34
S.-W. Kim *In its* Computational Fluid Dynamics Symposium on Aeropropulsion Jan. 1991 p 393-407 (For primary document see N91-21062 13-02)
(NASA Order C-99066-G)
Avail: NTIS HC/MF A99; 10 functional color pages CSCL 20D

A numerical investigation of incompressible and compressible turbulent flows over strongly curved surfaces is presented. The turbulent flow equations are solved by a pressure based Navier-Stokes equations solver. In the method, the conservation of mass equation is replaced by a pressure correction equation applicable for both compressible and incompressible flows. The turbulence is described by a multiple time scale turbulence model supplemented with a near-wall turbulence model. The numerical results show that the internal layer is a strong turbulence field which is developed beneath the external boundary layer and is located very close to the wall. The development of the internal layer is attributed to the enormous mean flow strain rate caused by the streamline curvature. The external boundary layer flow responds rather slowly to the streamline curvature. Thus, the turbulence field of the forward corner of the curved hill is characterized by two turbulence fields interacting with each other. The turbulence intensity of the internal layer is much stronger than that of the external boundary layer, so that the development of a new boundary layer in the downstream region of the curved hill depends mostly on the internal layer. These numerical results are in good agreement with the measured data, and show that the turbulence model can resolve the turbulence field subjected to the strong streamline curvature. Author

N91-21084*# Analytical Services and Materials, Inc., Hampton, VA.
COMPUTATION OF TURBULENT HIGH SPEED MIXING LAYERS USING A TWO-EQUATION TURBULENCE MODEL c34
J. R. Narayan and B. Sekar (Vigyan Research Associates, Inc., Hampton, VA.) *In* NASA, Lewis Research Center, Computational Fluid Dynamics Symposium on Aeropropulsion Jan. 1991 p 409-428 (For primary document see N91-21062 13-02)
(Contracts NAS1-18599; NAS1-18585)
Avail: NTIS HC/MF A99; 10 functional color pages CSCL 20D

A two-equation turbulence model was extended to be applicable for compressible flows. A compressibility correction based on modelling the dilational terms in the Reynolds stress equations were included in the model. The model is used in conjunction with the SPARK code for the computation of high speed mixing layers. The observed trend of decreasing growth rate with increasing convective Mach number in compressible mixing layers is well predicted by the model. The predictions agree well with the experimental data and the results from a compressible Reynolds stress model. The present model appears to be well suited for the study of compressible free shear flows. Preliminary results obtained for the reacting mixing layers are included. Author

N91-21085*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
HEAT TRANSFER, VELOCITY-TEMPERATURE CORRELATION, AND TURBULENT SHEAR STRESS FROM NAVIER-STOKES COMPUTATIONS OF SHOCK WAVE/TURBULENT BOUNDARY LAYER INTERACTION FLOWS c34
C. R. Wang, W. R. Hingst, and A. R. Porro *In its* Computational Fluid Dynamics Symposium on Aeropropulsion Jan. 1991 p 429-456 (For primary document see N91-21062 13-02)
Avail: NTIS HC/MF A99; 10 functional color pages CSCL 20D

The properties of 2-D shock wave/turbulent boundary layer interaction flows were calculated by using a compressible turbulent Navier-Stokes numerical computational code. Interaction flows caused by oblique shock wave impingement on the turbulent boundary layer flow were considered. The oblique shock waves were induced with shock generators at angles of attack less than 10 degs in supersonic flows. The surface temperatures were kept at near-adiabatic (ratio of wall static temperature to free stream total temperature) and cold wall (ratio of wall static temperature to free stream total temperature) conditions. The computational results were studied for the surface heat transfer, velocity temperature correlation, and turbulent shear stress in the interaction flow fields. Comparisons of the computational results with existing measurements indicated that (1) the surface heat transfer rates and surface pressures could be correlated with Holden's relationship, (2) the mean flow streamwise velocity components and static temperatures could be correlated with Crocco's relationship if flow separation did not occur, and (3) the Baldwin-Lomax turbulence model should be modified for turbulent shear stress computations in the interaction flows. Author

N91-21086*# Pennsylvania State Univ., University Park.
WAVE MODELS FOR TURBULENT FREE SHEAR FLOWS c34
W. W. Liou and P. J. Morris *In* NASA, Lewis Research Center, Computational Fluid Dynamics Symposium on Aeropropulsion Jan. 1991 p 457-471 (For primary document see N91-21062 13-02)
Avail: NTIS HC/MF A99; 10 functional color pages CSCL 20D

New predictive closure models for turbulent free shear flows are presented. They are based on an instability wave description of the dominant large scale structures in these flows using a

quasi-linear theory. Three model were developed to study the structural dynamics of turbulent motions of different scales in free shear flows. The local characteristics of the large scale motions are described using linear theory. Their amplitude is determined from an energy integral analysis. The models were applied to the study of an incompressible free mixing layer. In all cases, predictions are made for the development of the mean flow field. In the last model, predictions of the time dependent motion of the large scale structure of the mixing region are made. The predictions show good agreement with experimental observations. Author

N91-21087*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
COMPUTATION OF LAMINAR VISCOUS-INVISCID INTERACTIONS IN HIGH-SPEED INTERNAL FLOWS c34
David H. Rudy, James L. Thomas, and Ajay Kumar *In* NASA, Lewis Research Center, Computational Fluid Dynamics Symposium on Aeropropulsion Jan. 1991 p 473-486 (For primary document see N91-21062 13-02)
Avail: NTIS HC/MF A99; 10 functional color pages CSCL 20D

A review is given of computations for a series of nominally 2-D laminar viscous-inviscid interactions. Comparisons were made with detailed experimental shock tunnel results. The shock wave boundary layer interactions considered were induced by a compression ramp in one case and by an externally generated incident shock in the second case. In general, good agreement was reached between the grid refined calculations and experiment for the incipient and small separation conditions. For the highly separated flow, 3-D calculations which included the finite span effects of the experiment were required in order to obtain agreement with the data. Author

N91-21088*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
TWO AND THREE-DIMENSIONAL SHOCK-SHOCK INTERACTIONS ON THE BLUNT LEADING EDGES OF THE HYPERSONIC INLETS c34
D. J. Singh, Ajay Kumar, and S. N. Tiwari (Old Dominion Univ., Norfolk, VA.) *In* NASA, Lewis Research Center, Computational Fluid Dynamics Symposium on Aeropropulsion Jan. 1991 p 487-506 (For primary document see N91-21062 13-02)
Avail: NTIS HC/MF A99; 10 functional color pages CSCL 20D

The effect of shock impingement on the blunt leading edges of the top and sidewall compression type inlet of a scramjet engine is studied numerically. The impinging shock is caused by the vehicle forebody. The interaction of this forebody shock with the inlet leading edge shock results in a very complex flowfield containing local regions of high pressure and intense heating. This complex flowfield in calculated by solving the Navier-Stokes equations using a finite volume flux splitting technique due to van Leer. To resolve the finer details of the flow structure as well as to predict the surface heat transfer accurately, adaptive grid technique is used in the analysis. Results of the present numerical study are compared with available experimental results. Author

N91-21089*# Analytical Services and Materials, Inc., Hampton, VA.
ZONAL ANALYSIS OF TWO HIGH-SPEED INLETS c34
A. D. Dilley, G. F. Switzer, and W. M. Eppard *In* NASA, Lewis Research Center, Computational Fluid Dynamics Symposium on Aeropropulsion Jan. 1991 p 507-519 (For primary document see N91-21062 13-02)
(Contract NAS1-18599)
Avail: NTIS HC/MF A99; 10 functional color pages CSCL 20D

Using a zonal technique, thin layer Navier-Stokes solutions for two high speed inlet geometries are presented and compared with experimental data. The first configuration consists of a 3-D inlet preceded by a sharp flat plate. Results with two different grids demonstrate the importance of adequate grid refinement in high speed internal flow computations. The fine grid solution has reasonably good agreement with experimental heat transfer and pressure values inside the inlet. The other configuration consists of a 3-D inlet mounted on a research hypersonic forebody. Numerical results for this configuration have good agreement with experimental pressure data along the forebody, but not inside the inlet. A more refined grid calculation is currently being done to better predict the flowfield in the inlet. Author

N91-21090*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
DYNAMICS OF LOCAL GRID MANIPULATIONS FOR INTERNAL FLOW PROBLEMS c34
Peter R. Eiseman (Program Development Corp., White Plains, NY.), Aaron Snyder, and Yung K. Choo *In its* Computational Fluid Dynamics Symposium on Aeropropulsion Jan. 1991 p 521-546 (For primary document see N91-21062 13-02)
(Contract NAG3-877; F49620-89-C-0096)
Avail: NTIS HC/MF A99; 10 functional color pages CSCL 20D

The control point method of algebraic grid generation is briefly reviewed. The review proceeds from the general statement of the method in 2-D unencumbered by detailed mathematical formulation. The method is supported by an introspective discussion which provides the basis for confidence in the approach. The more complex 3-D formulation is then presented as a natural generalization. Application of the method is carried out through 2-D examples which demonstrate the technique. Author

N91-21091*# Illinois Univ., Urbana. Aeronautical and Astronautical Engineering.
GRID GENERATION STRATEGIES FOR TURBOMACHINERY CONFIGURATIONS c34
K. D. Lee and T. L. Henderson *In* NASA, Lewis Research Center, Computational Fluid Dynamics Symposium on Aeropropulsion Jan. 1991 p 547-558 (For primary document see N91-21062 13-02)
Avail: NTIS HC/MF A99; 10 functional color pages CSCL 20D

Turbomachinery flow fields involve unique grid generation issues due to their geometrical and physical characteristics. Several strategic approaches are discussed to generate quality grids. The grid quality is further enhanced through blending and adapting. Grid blending smooths the grids locally through averaging and diffusion operators. Grid adaptation redistributes the grid points based on a grid quality assessment. These methods are demonstrated with several examples. Author

N91-21092*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
THE 3D COMPUTATION OF SINGLE-EXPANSION-RAMP AND SCRAMJET NOZZLES c34
H. T. Lai *In its* Computational Fluid Dynamics Symposium on Aeropropulsion Jan. 1991 p 559-582 (For primary document see N91-21062 13-02)
Avail: NTIS HC/MF A99; 10 functional color pages CSCL 20D

A description of the computations for three-dimensional nonaxisymmetric nozzles and an analysis of the flowfields are presented. Two different types of nozzles are investigated for compressible flows at high Reynolds numbers. These are the single-expansion-ramp and scramjet nozzles. The computation for the single-expansion-ramp nozzle focuses on the condition of low pressure ratio, which requires the simulation for turbulent flow that is not needed at high pressure ratios. The flowfield contains the external quiescent air, and the internal regions of subsonic and low supersonic flows. The second type is the scramjet nozzle, which typically has a very large area ratio and is designed to operate at high speeds and pressure ratios. The freestream external flow has a Mach number of 6, and the internal flow leaving the combustion chamber is at a Mach number of 1.62. The flowfield is mostly supersonic except in the viscous region near walls. The computed results from both cases are compared with experimental data for the surface pressure distributions. Author

N91-21093*# Cincinnati Univ., OH. Dept. of Aerospace Engineering and Engineering Mechanics.
SOLUTION OF THREE-DIMENSIONAL AFTERBODY FLOW USING REDUCED NAVIER-STOKES EQUATIONS c34

H. M. H. Almahroos, P. K. Khosla, and S. G. Rubin *In* NASA, Lewis Research Center, Computational Fluid Dynamics Symposium on Aeropropulsion Jan. 1991 p 583-592 (For primary document see N91-21062 13-02)
(Grant AF-AFOSR-0096-90)
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The flow over afterbody geometries was investigated using the reduced Navier-Stokes (RNS) approximation. Both pressure velocity flux-split and composites velocity primitive variable formulations were considered. Pressure or pseudopotential relaxation procedures are combined with sparse matrix or coupled strongly implicit algorithms to form a three-dimensional solver for general non-orthogonal coordinates. Three-dimensional subsonic and transonic viscous/inviscid interacting flows were evaluated. Solutions with and without regions of recirculation were obtained. Author

N91-21094*# Sverdrup Technology, Inc., Cleveland, OH.
RECENT UPDATE OF THE RPLUS2D/3D CODES c34
Y.-L. Peter Tsai *In* NASA, Lewis Research Center, Computational Fluid Dynamics Symposium on Aeropropulsion Jan. 1991 p 593-607 (For primary document see N91-21062 13-02)
(Contract NAS3-25266)
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The development of the RPLUS2D/3D codes is summarized. These codes utilize LU algorithms to solve chemical non-equilibrium flows in a body-fitted coordinate system. The motivation behind the development of these codes is the need to numerically predict chemical non-equilibrium flows for the National AeroSpace Plane Program. Recent improvements include vectorization method, blocking algorithms for geometric flexibility, out-of-core storage for large-size problems, and an LU-SW/UP combination for CPU-time efficiency and solution quality. Author

N91-21095*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
THE DIRECT SIMULATION OF HIGH-SPEED MIXING-LAYERS WITHOUT AND WITH CHEMICAL HEAT RELEASE c34
B. Sekar, H. S. Mukunda (Indian Inst. of Science, Bangalore.), and M. H. Carpenter *In* NASA, Lewis Research Center, Computational Fluid Dynamics Symposium on Aeropropulsion Jan. 1991 p 609-622 (For primary document see N91-21062 13-02)
(Contract NAS1-18585)
Avail: NTIS HC/MF A99; 10 functional color pages CSCL 20D

A direct numerical simulation of high speed reacting and non-reacting flows for H2-air systems is presented. The calculations are made for a convective Mach number of 0.38 with hyperbolic tangent initial profile and finite rate chemical reactions. A higher-order numerical method is used in time accurate mode to time advance the solution to a statistical steady state. About 600 time slices of all the variables are then stored for statistical analysis. It is shown that most of the problems of high-speed combustion with air are characterized by relatively weak heat release. The present study shows that: (1) the convective speed is reduced by heat release by about 10 percent at this convective Mach number M(sub c) = 0.38; (2) the variation of the mean and rms fluctuation of temperature can be explained on the basis of temperature fluctuation between the flame temperature and the ambient; (3) the growth rate with heat release is reduced by 7 percent; and (4) the entrainment is reduced by 25 percent with heat release. These differences are small in comparison with incompressible flow dynamics, and are argued to be due to the reduced importance of heat release in comparison with the large enthalpy gradients resulting from the large-scale vortex dynamics. It is finally suggested that the problems of reduced mixing in high-speed flows are not severely complicated by heat release. Author

N91-21096*# La Sapienza Univ., Rome (Italy). Dipt. di Meccanica e Aeronautica.
COMPUTATIONAL MODELLING OF DUMP COMBUSTORS FLOWFIELD c34
D. Lentini and W. P. Jones (Imperial Coll. of Science and Technology, London, England) *In* NASA, Lewis Research Center, Computational Fluid Dynamics Symposium on Aeropropulsion Jan. 1991 p 623-634 (For primary document see N91-21062 13-02)
Avail: NTIS HC/MF A99; 10 functional color pages CSCL 20D

A computational model aimed at predicting the flowfield of dump combustors is presented. The turbulent combustion model is based on the conserved scalar approach and on a convenient specification of its probability density function, which reduces the computation of the mean density to a closed form. Turbulence is modeled by means of the k-epsilon model. The averaged conservation equations are solved by a technique based on a staggered grid and on the SIMPLE solver. The computational model is applied to a simple dump combustor to assess the computer time requirements and accuracy. The turbulent combustion model is shown to reduce the computer time by an order of magnitude when compared to evaluating the mean density by numerical quadrature. Author

N91-21097*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
NUMERICAL SIMULATION OF TRANSVERSE FUEL INJECTION c34
Marlon Mao, David W. Riggins (Analytical Services and Materials, Inc., Hampton, VA.), and Charles R. McClinton *In* NASA, Lewis Research Center, Computational Fluid Dynamics Symposium on Aeropropulsion Jan. 1991 p 635-667 (For primary document see N91-21062 13-02)
Avail: NTIS HC/MF A99; 10 functional color pages CSCL 20D

A review of recent work at NASA Langley Research Center to compare the predictions of transverse fuel injector flow fields and mixing performance with experimental results is presented. Various cold (non-reactive) mixing studies were selected for code calibration which include the effects of boundary layer thickness and injection angle for sonic hydrogen injection into supersonic air. Angled injection of helium is also included. This study was performed using both the three-dimensional elliptic and the parabolized Navier-Stokes (PNS) versions of SPARK. Axial solution planes were passed from PNS to elliptic and elliptic to PNS in order to efficiently generate solutions. The PNS version is used both upstream and far downstream of the injector where the flow can be considered parabolic in nature. The comparisons are used to identify experimental deficiencies and computational procedures to improve agreement. Author

N91-21098*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
A HIGHLY EFFICIENT ENGINEERING TOOL FOR THREE-DIMENSIONAL SCRAMJET FLOWFIELD AND HEAT TRANSFER COMPUTATIONS c34
Pradeep S. Kamath, Richard W. Hawkins, Nathaniel R. Baker (Lockheed Engineering and Sciences Co., Hampton, VA.), and Charles R. McClinton *In* NASA, Lewis Research Center, Computational Fluid Dynamics Symposium on Aeropropulsion Jan. 1991 p 669-681 (For primary document see N91-21062 13-02)
Avail: NTIS HC/MF A99; 10 functional color pages CSCL 20D

The SIMPLE-based parabolic flow code, SHIP3D, was under development for use as a parametric design and analysis tool for scramjets. Some capabilities and applications of the code are demonstrated, and a report on its current status is given. The focus is on the combustor for which the code was mostly used. Recently, it was also applied to nozzle flows. Code validation results are presented for combustor unit problems involving film cooling, transverse fuel injection, and nozzle test. A parametric study of a film cooled or transpiration cooled Mach 16 combustor is also conducted to illustrate the application of the code to a design problem. Author

N91-21099*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
ON THE NONLINEAR STABILITY OF A HIGH-SPEED, AXISYMMETRIC BOUNDARY LAYER Final Report

C. David Pruett, Lian L. Ng (National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.), and Gordon Erlebacher Mar. 1991 47 p Submitted for publication (Contract NAS1-18605)
(NASA-CR-187538; ICASE-91-30; NAS 1.26:187538) Avail: NTIS HC/MF A03 CSCL 01A

The stability of a high-speed, axisymmetric boundary layer is investigated using secondary instability theory and direct numerical simulation. Parametric studies based on the temporal secondary instability theory identify subharmonic secondary instability as a likely path to transition on a cylinder at Mach 4.5. The theoretical predictions are validated by direct numerical simulation at temporally-evolving primary and secondary disturbances in an axisymmetric boundary-layer flow. At small amplitudes of the secondary disturbance, predicted growth rates agree to several significant digits with values obtained from the spectrally-accurate solution of the compressible Navier-Stokes equations. Qualitative agreement persists to large amplitudes of the secondary disturbance. Moderate transverse curvature is shown to significantly affect the growth rate of axisymmetric second mode disturbances, the likely candidates of primary instability. The influence of curvature on secondary instability is largely indirect but most probably significant, through modulation of the primary disturbance amplitude. Subharmonic secondary instability is shown to be predominantly inviscid in nature, and to account for spikes in the Reynolds stress components at or near the critical layer. Author

N91-21100*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Aerospace and Ocean Engineering.
VELOCITY MEASUREMENTS IN A TURBULENT TRAILING VORTEX AND THEIR APPLICATION TO BWI NOISE PREDICTION Semiannual Report
William J. Devenport and Stewart A. L. Glegg (Florida Atlantic Univ., Boca Raton.) Apr. 1991 32 p
(Grant NAG1-1119)
(NASA-CR-188083; NAS 1.26:188083) Avail: NTIS HC/MF A03 CSCL 01A

The objectives were to observe the turbulence structure and spectral characteristics of the trailing vortex shed by a rectangular NACA 0012 wing over a range of conditions and to incorporate these observations into the blade-wake interaction (BWI) noise-prediction method of Glegg (1989). The following sections are presented: (1) measurements performed during the first year of this two year investigation; (2) presentation and discussion of a representative sample of the results; (3) implications for the BWI noise prediction method; and (4) re-evaluation of work planned for the second year. Author

N91-21101*# Imperial Coll. of Science and Technology, London (England). Dept. of Aeronautics.
FINITE ELEMENT METHODS FOR INTEGRATED AERODYNAMIC HEATING ANALYSIS Report, 1 Oct. 1989 - 30 Sep. 1990
J. Peraire 30 Sep. 1990 44 p
(Grant NAGw-1809)
(NASA-CR-188079; NAS 1.26:188079) Avail: NTIS HC/MF A03 CSCL 01A

Over the past few years finite element based procedures for the solution of high speed viscous compressible flows were developed. The objective of this research is to build upon the finite element concepts which have already been demonstrated and to develop these ideas to produce a method which is applicable to the solution of large scale practical problems. The problems of interest range from three dimensional full vehicle Euler simulations to local analysis of three-dimensional viscous laminar flow. Transient Euler flow simulations involving moving bodies are also to be included. An important feature of the research is to be the coupling of the flow solution methods with thermal/structural modeling techniques to provide an integrated fluid/thermal/structural modeling capability. The progress made towards achieving these goals during the first twelve month period of the research is presented. Author

N91-21102 ESDU International Ltd., London (England).
COMPUTER PROGRAM FOR THE CALCULATION OF NORMAL FORCE AND PITCHING MOMENT OF FOREBODY-CYLINDER COMBINATIONS AT ANGLES OF ATTACK UP TO 90 DEGREES AND MACH NUMBERS UP TO 5, INCLUDING EFFECTS OF CONICAL BOAT-TAILING
Dec. 1990 45 p
(ESDU-90034; ISBN-0-85679-760-X; ISSN-0141-397X) Avail: ESDU

ESDU 90034 gives the Fortran program listing of the prediction method. It uses ESDU 77028 to obtain the required geometric properties of the various axisymmetric forebody shapes, the method of ESDU 89008 for normal-force-curve and pitching-moment-curve slopes at zero angle of attack, and the method of ESDU 89014 for normal force, pitching moment, and center of pressure position at angle of attack modified, if required, by the method of ESDU 87033 to allow for the effects of any boat-tailing. The input data required and the interpretation of the output are described and illustrated with three worked examples. The limitations of the program are those of the original prediction methods on which it is based, and if any of them are exceeded the program stops and provides an appropriate error message. ESDU

N91-21103 ESDU International Ltd., London (England).
STRUCTURES OF NON-CIRCULAR CROSS-SECTION: DYNAMIC RESPONSE DUE TO VORTEX SHEDDING
Dec. 1990 53 p
(ESDU-90036; ISBN-0-85679-762-6; ISSN-0143-2702) Avail: ESDU

A calculation procedure for across-wind response in uniform of shear flow to vortex shedding or isolated structures such as buildings, towers or stacks, and structural elements is given. The semi-empirical method was developed from correlations of measurements extracted from the literature for regular non-circular cross-section parallel-sided structures with sharp corners symmetrically aligned to the flow. Such shapes include square, rectangular, triangular, and polygonal cross-sections and typical structural member shapes such as I- or H-section beams. The method is summarized in a calculation sheet and is illustrated with fully-worked examples. Author

N91-21104# Institut Franco-Allemand de Recherches, Saint-Louis (France).
INFRARED THERMOGRAPHY FOR THE QUALITATIVE AERODYNAMIC STUDY OF A SLENDER BODY [THERMOGRAPHIE INFRAROUGE APPLIQUEE A L'AERODYNAMIQUE D'UN CORPS FUSELE. ETUDE QUALITATIVE]
E. Cattin and F. Jagusinski 18 Sep. 1989 41 p In FRENCH Original contains color illustrations
(ISL-R-122/89; ETN-91-98989) Avail: NTIS HC/MF A03

The flow and the variations of the wall temperature of a slender body are studied in the case of an increase of 50 C in relation to the ambient temperature. Tests were carried out with a model made of insulating material located in a jet to detect the presence of unsticking and resticking areas. To evaluate the accuracy and the reliability of a thermography, a comparison with velocimetry laser measurements was made. An extension of the method to three dimensional phenomena is considered. ESA

N91-21105# Institut Franco-Allemand de Recherches, Saint-Louis (France).
PRACTICAL METHODS TO EVALUATE THE FRICTION DRAG COEFFICIENT OF A PROJECTILE IN FREE FLIGHT [SUR LES METHODES PRATIQUES D'EVALUATION DU COEFFICIENT DE TRAINEE DE FROTTEMENT D'UN PROJECTILE EN VOL LIBRE]
A. D. Dupuis and M. Giraud 1 Sep. 1989 109 p In FRENCH
(ISL-R-123/89; ETN-91-98990) Avail: NTIS HC/MF A06

A comparison between the usual method to calculate the drag coefficients for a free flight motion is presented. The laminar and turbulent boundary layers were studied and the possible shapes of the cylindrical projectile were considered. The influence of the

local conditions of the coefficients were taken into account as well as the compressibility coefficients and the wall temperature. A program in FORTRAN for the calculation of the drag and shape coefficients for a projectile of revoltion was proposed. The comparison between theory and experiment shows a good agreement of the results. ESA

N91-21106# Institut Franco-Allemand de Recherches, Saint-Louis (France).
COMPARISON STUDY OF THE AERODYNAMIC COEFFICIENTS MEASURED ON MODELS WITH CIRCULAR OR SQUARED SECTION AND LARGE ELONGATION IN SUPERSONIC FLOW [ETUDE COMPAREE DES COEFFICIENTS AERODYNAMIQUES MESURES SUR DES MAQUETTES DE SECTION CIRCULAIRE OU CARREE DE GRAND ALLONGEMENT EN ECOULEMENT SUPERSONIQUE]
B. Gautier, A. Koeneke, J.-P. Duperoux, and E. Cattin 22 Nov. 1989 43 p In FRENCH
(ISL-R-125/89; ETN-91-98992) Avail: NTIS HC/MF A03

Aerodynamic coefficients of ogives are measured for the Mach numbers 1.7 and 3.02. The Reynolds number was based on the caliber and the maximal incidence was 30 deg. It is shown that the linearized theory is a good approximation for models of circular cross section until an incidence of 20 deg. It is noticed that the transition of a circular section to a squared section produces an increasing of the coefficient for transonic flows. For models with a squared section, the rolling angle has a significant influence and the lift drag ratio is maximum for an angle of 45 deg. ESA

N91-21107# Institut Franco-Allemand de Recherches, Saint-Louis (France).
DEEP OVERHEATING OF THIN BODIES IN FLIGHT WITH VERY LOW-ANGLED TRAJECTORY [DIE DURCHWAERMUNG VON DUENNEN KOERPERN IM HYPERRASANTEN FLUG]
K. W. Naumann and G. Smeets 28 Nov. 1989 44 p In GERMAN
(ISL-R-126/89; ETN-91-98993) Avail: NTIS HC/MF A03

A direct analytical method is perfected to calculate the deep overheating of projectiles subjected to tangential flows. The velocities varied from 1500 to 3000 m/s, the dissociation effects were neglected, and the extension of the Reynolds analogy by Prandtl and Taylor was used to evaluate the heat transfer. The mean temperature of a body was obtained as a function of heating time, flight velocity, air state and material by means of a heating coefficient and a family of generalized curves. ESA

N91-21108# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.). Abt. Mathematische Verfahren und Datentechnik.
FLIGHT PATH RECONSTRUCTION USING EXTENDED KALMAN FILTERING TECHNIQUES
Venkataraman Parameswaran (National Aeronautical Lab., Bangalore, India) and Ermin Plaetschke Aug. 1990 38 p
(DLR-FB-90-41; ISSN-0171-1342; ETN-91-99036) Avail: NTIS HC/MF A03; DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 16 DM

A Flight Path Reconstruction (FPR) algorithm for the estimation of unknown constant bias and scale factor errors in measured data using extended Kalman filter and fixed interval smoother was developed. The models are based on the six degree of freedom kinematic equations relating measured aircraft responses. The technique is demonstrated with the aid of a typical example using flight test data. Also some sensitivity studies on the variation of noise covariance matrices were carried out. The results of flight path reconstruction using extended Kalman filter and maximum likelihood methods are presented. Estimation of aerodynamic parameters is carried out with a simple model using data sets which, on the one hand, were corrected for measurement bias and scale factor errors and, on the other hand, were not corrected. The effect of mesurement errors on the aerodynamic derivatives is demonstrated. ESA

N91-21109# Aeronautical Research Inst. of Sweden, Stockholm. Dept. of Aerodynamics.
LOW SPEED WIND TUNNEL INVESTIGATION OF PROPELLER SLIPSTREAM AERODYNAMIC EFFECTS ON DIFFERENT NACELLE/WING COMBINATIONS. PART 2: PROPELLER SLIPSTREAM FLOW FIELD SURVEYS (VELOCITY COMPONENTS, DYNAMIC, TOTAL AND STATIC PRESSURE DISTRIBUTIONS) AT ZERO ANGLE OF ATTACK AND HIGH POWER
Ingemar Samuelsson Oct. 1990 173 p Sponsored by National Swedish Board for Technical Development, Stockholm
(FFA-TN-1990-24-Pt-2; ETN-91-99042) Avail: NTIS HC/MF A08

A low speed wind tunnel investigation of the propeller slipstream flow fields around four wing/nacelle combinations was carried out. The flow fields were surveyed by means of a five hole pressure probe at zero angle of attack. The test was performed at a free stream speed of 50 m/s with a thrust coefficient (0.23) and at advance ratio J = 0.70 corresponding to a rather high power condition. The results (slipstream velocities and pressures) are shown versus radius for at least three different axial survey planes along the nacelle for the four configurations. The experimental data show that there could be large effects on the velocity and pressure distributions within the slipstream from the nacelle shapes and from the presence of the wing in the slipstream. This could lead to rather large asymmetrical nacelle loads. The results seem to indicate that the wing influence of the propeller inflow is small, at least for the tested wing configurations. The wing has, however, a strong influence on the location of the slipstream boundaries since these boundaries are sheared by the wing. Due to the rotating slipstream there is a certain amount of swirl recovery attributed to the induced flow around the wing leading edges. For the case tested (with J = 0.70) there still remains a large amount of swirl in the slipstream downstream of the wing, so the swirl recovery is far from complete. The investigation also shows the presence of the propeller tip vortices at the slipstream boundary as marked gradients in the pressures and that there is a distinct tip loss of thrust associated with total pressure loss in the viscous tip vortex cores. ESA

N91-21110# Aeronautical Research Inst. of Sweden, Stockholm. Dept. of Aerodynamics.
MATGRID, A PROGRAM FOR GENERATION OF C-H AND C-O TOPOLOGY GRIDS AROUND WING/BODY CONFIGURATIONS: USER'S GUIDE
Sven G. Hedman and Lars G. Tysell Dec. 1990 63 p Sponsored by National Swedish Board for Technical Development, Stockholm
(FFA-TN-1991-03; ETN-91-99047) Avail: NTIS HC/MF A04

MATGRID is a computer program for generation of C-H or C-O topology grids for the discretization of flow fields around configurations consisting of a wing alone or a wing and a fuselage. It was developed primarily for use together with the full potential flow solver MATRIĆS. The principles for MATGRID, the files required, some parameters, how to modify the input, and how to run the program are described. An example is included as a test case. ESA

N91-21111# National Aerospace Lab., Tokyo (Japan).
CONING MOTION OF SLENDER BODIES AT HIGH ANGLES OF ATTACK
Atsushi Tate, Takashi Yoshinaga, and Kenji Inoue Mar. 1990 39 p In JAPANESE; ENGLISH summary
(NAL-TR-1059; ISSN-0389-4010) Avail: NTIS HC/MF A03

The experimental results are presented for the coming motion of slender bodies such as a cone-cylinder or a cylinder model created by the side force at high angles of attack (45 deg less than or equal to alpha less than or equal to 135 deg). The free rotation motion was utilized to study the coning angular motions of the models. Models were supported free to rotate at their centers of gravity in a low speed wind tunnel. For angles of attack of 45 deg less or equal to alpha less or equal to 90 deg (nose first), a cone-cylinder model shows a steady angular rotation. For the range of 90 deg less than or equal to alpha less than or equal to 135

deg (base first), the model shows alternating rotation where the direction of rotation reverses within a certain period of time.
Author

N91-21112# National Aerospace Lab., Tokyo (Japan).
WIND TUNNEL TEST OF A PROPELLER WORKING IN A LOW REYNOLDS NUMBER RANGE
Kingo Takasawa, Masataka Hashidate, and Osamu Nonaka Jun. 1990 39 p In JAPANESE; ENGLISH summary
(NAL-TR-1071; ISSN-0389-4010) Avail: NTIS HC/MF A03

An optimum propeller design, whose representative Reynolds number is between 1 and 2 x 10(exp 5), was tested in the NAL large low-speed wind tunnel. After removing the wind tunnel interference effects, the test results were compared with predictions by a computer program based on Adkins and Liebeck's theory. Thrust predictions show very good coincidence with test results. Torque predictions show fairly good coincidence. The difference between the theoretical predictions and experimental values are thought to be attributable to the shrinkage of the drag bucket in propeller blade sections, compared with the two-dimensional airfoil data. The aerodynamics design method of propellers working in the low Reynolds number range was established. The computer program is very useful in designing propellers for man-powered airplanes and motor soarers, as well as microwave powered airplanes.
Author

N91-21113# National Aerospace Lab., Tokyo (Japan).
AN EXPERIMENTAL STUDY OF A THREE-DIMENSIONAL SWEPT-BACK WING WITH SUCTION LAMINAR-FLOW-CONTROL
Yoji Ishida, Masayoshi Noguchi, Shigeo Kayaba, Osamu Nonaka, and Hideo Hoshino Jul. 1990 23 p In JAPANESE; ENGLISH summary
(NAL-TR-1072; ISSN-0389-4010) Avail: NTIS HC/MF A03

A wind tunnel test of a three-dimensional swept-back wing with suction laminar flow control (LFC) was executed to investigate the drag reduction effect of the LFC under various test conditions. The wing model has a hybrid suction surface which consists of a porous surface with very fine holes from near the leading edge to 25 percent chord and a slotted surface with a large number of fine slots from 25 to 80 percent chord. Total drag, C(sub DT), which is defined as the sum of the wake drag and the equivalent drag, was measured for various suction quantities. Application of the optimum suction quantities, which were determined so as to delay the natural transition points up to 90 percent chord with the minimum total suction quantity for each test condition, gives a fairly large drag reduction (about 40 percent) compared with the no suction case for Reynolds numbers up to 3.6 x 10(exp 6). A suction applied only in the leading edge region also gives not a little drag reduction, but a suction in the rear part of the wing where the boundary layer flow is already turbulent has no effect on the drag reduction. It was observed that when there is no suction the porous suction surface generates much earlier transitions than does the solid surface. As transition is a very important problem for practical application of LFC, further investigation will be required.
Author

N91-21114# National Aerospace Lab., Tokyo (Japan).
BLUNT TRAILING EDGE ANALYSIS OF SUPERCRITICAL AIRFOILS BY A NAVIER-STOKES CODE
Naoki Hirose and Nobuhiko Kamiya Aug. 1990 26 p Previously announced in IAA as A91-24424
(NAL-TR-1075-T; ISSN-0389-4010) Avail: NTIS HC/MF A03

A preliminary analysis of flow about the blunt trailing edge of the NACA 0012 and supercritical airfoils in transonic speed was made utilizing a 2-D time-averaged Navier-Stokes code with the turbulence model of Baldwin and Lomax. A very fine mesh distribution was focused at the trailing edge region which conventional codes treat as a sharp trailing edge with zero thickness. Computation was made for the NACA 0012 airfoil with three kinds of trailing edge thicknesses, cusp-type sharp, standard and 1 percent thickness and was compared with the result of a conventionally-treated trailing edge. A fifteen percent thickness supercritical airfoil with a trailing edge thickness of 0.5 percent was also analyzed. It was found that a vortex shedding similar to the Karman vortices is formed and surface pressure near the trailing edge shows unsteady oscillation due to the vortices. The magnitude and periodicity of the oscillation is governed by the bluntness. Also, it was shown that the Kutta condition is not necessarily satisfied for the blunt trailing edge.
Author

N91-21115*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
AN EXPERIMENTAL COMPARISON OF NONSWIRLING AND SWIRLING FLOW IN A CIRCULAR-TO-RECTANGULAR TRANSITION DUCT
B. A. Reichert, W. R. Hingst, and T. H. Okiishi (Iowa State Univ. of Science and Technology, Ames.) Jan. 1991 15 p Presented at the 29th Aerospace Sciences Meeting, Reno, NV, 7-10 Jan. 1991; sponsored in part by AIAA Previously announced in IAA as A91-21466
(NASA-TM-104359; E-6149; NAS 1.15:104359; AIAA-91-0342)
Avail: NTIS HC/MF A03 CSCL 01A

Circular-to-rectangular transition ducts are used as exhaust system components of aircraft with rectangular exhaust nozzles. Often, the incoming flow of these transition ducts includes a swirling velocity component remaining from the gas turbine engine. Previous transition duct studies have either not included inlet swirl or when inlet swirl was considered, only overall performance parameters were evaluated. Circular-to-rectangular transition duct flows with and without inlet swirl were explored in order to understand the effect of inlet swirl on the transition duct flow field and to provide detailed duct flow data for comparison with numerical code predictions. A method was devised to create a swirling, solid body rotational flow with minimal associated disturbances. Coefficients based on velocities and total and static pressures measured incross stream planes at four axial locations within the transition duct, along with surface static pressure measurements and surface oil film visualization, are presented for both nonswirling and swirling incoming flow. In both cases the inlet centerline Mach number was 0.35. The Reynolds number based on the inlet centerline velocity and duct inlet diameter was 1,547,000 for nonswirling and 1,366,000 for swirling flow. The maximum swirl angle was 15.6 deg. Two pair of counter-rotating side wall vortices appeared in the duct flow without inlet swirl. These vortices were absent in the swirling incoming flow cases.
Author

N91-21116*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
HOT GAS INGESTION TEST RESULTS OF A TWO-POSTER VECTORED THRUST CONCEPT WITH FLOW VISUALIZATION IN THE NASA LEWIS 9- X 15-FOOT LOW SPEED WIND TUNNEL
Albert L. Johns, George Neiner, Timothy J. Bencic, Joseph D. Flood, Kurt C. Amuedo, and Thomas W. Strock (McDonnell-Douglas Corp., Saint Louis, MO.) Jul. 1990 27 p Presented at the 26th Joint Propulsion Conference, Orlando, FL, 16-18 Jul. 1990; sponsored in part by AIAA, SAE, ASME, and ASEE Original contains color illustrations
(NASA-TM-103258; E-5690; NAS 1.15:103258; AIAA-90-2268)
Avail: NTIS HC/MF A03; 1 functional color page CSCL 01A

A 9.2 percent scale Short Takeoff and Vertical Landing (STOVL) hot gas ingestion model was designed and built by McDonnell Douglas Corporation (MCAIR) and tested in the Lewis Research Center 9 x 15 foot Low Speed Wind Tunnel (LSWT). Hot gas ingestion, the entrainment of heated engine exhaust into the inlet flow field, is a key development issure for advanced short takeoff and vertical landing aircraft. Flow visualization from the Phase 1 test program, which evaluated the hot ingestion phenomena and control techniques, is covered. The Phase 2 test program evaluated the hot gas ingestion phenomena at higher temperatures and used a laser sheet to investigate the flow field. Hot gas ingestion levels were measured for the several forward nozzle splay configurations and with flow control/life improvement devices (LIDs) which reduced the hot gas ingestion. The model support system had four degrees of freedom - pitch, roll, yaw, and vertical height

variation. The model support system also provided heated high-pressure air for nozzle flow and a suction system exhaust for inlet flow. The test was conducted at full scale nozzle pressure ratios and inlet Mach numbers. Test and data analysis results from Phase 2 and flow visualization from both Phase 1 and 2 are documented. A description of the model and facility modifications is also provided. Headwind velocity was varied from 10 to 23 kn. Results are presented over a range of nozzle pressure ratios at a 10 kn headwind velocity. The Phase 2 program was conducted at exhaust nozzle temperatures up to 1460 R and utilized a sheet laser system for flow visualization of the model flow field in and out of ground effects. The results reported are for nozzle exhaust temperatures up to 1160 R. These results will contain the compressor face pressure and temperature distortions, the total pressure recovery, the inlet temperature rise, and the environmental effects of the hot gas. The environmental effects include the ground plane contours, the model airframe heating, and the location of the ground flow separation. Author

N91-21117*# Old Dominion Univ., Norfolk, VA. Dept. of Mechanical Engineering and Mechanics.

INVESTIGATION OF NOSE BLUNTNESS AND ANGLE OF ATTACK EFFECTS ON SLENDER BODIES IN VISCOUS HYPERTENSION FLOWS Progress Report, period ending 30 Apr. 1991

A. K. Sehgal, S. N. Tiwari, and D. J. Singh May 1991 124 p
(Contract NCC1-68; NAG1-363)
(NASA-CR-188153; NAS 1.26:188153) Avail: NTIS HC/MF A06 CSCL 01A

Hypersonic flows over cones and straight biconic configurations are calculated for a wide range of free stream conditions in which the gas behind the shock is treated as perfect. Effect of angle of attack and nose bluntness on these slender cones in air is studied extensively. The numerical procedures are based on the solution of complete Navier-Stokes equations at the nose section and parabolized Navier-Stokes equations further downstream. The flow field variables and surface quantities show significant differences when the angle of attack and nose bluntness are varied. The complete flow field is thoroughly analyzed with respect to velocity, temperature, pressure, and entropy profiles. The post shock flow field is studied in detail from the contour plots of Mach number, density, pressure, and temperature. The effect of nose bluntness for slender cones persists as far as 200 nose radii downstream. Author

N91-21118# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.

BIFURCATION ANALYSIS OF THE LONGITUDINAL DYNAMICS OF A SIMPLE POWERED LIFTING HYPERSONIC VEHICLE M.S. Thesis

Eric E. Fox Dec. 1990 102 p
(AD-A230826; AFIT/GAE/ENY/90D-07) Avail: NTIS HC/MF A06 CSCL 22/3

Bifurcation analysis was used to investigate the nonlinear behavior of a simple powered lifting hypersonic vehicle in circular orbit about a spherical nonrotating earth with gradients in atmospheric density and pressure and an inverse square law for gravity. Vehicle motion is constrained to a vertical plane so only longitudinal dynamics were modeled. Bifurcation analysis was conducted using the AUTO software package. A simple five-state model with three different thrust laws was derived to describe an unaugmented vehicle whose geometric and aerodynamic characteristics follow those of the literature. A parameter representing a body flap deflection was used to conduct one set of bifurcation sweeps for each thrust law. A second set of bifurcation sweeps for each thrust law was obtained using a parameter representing a throttle which scaled the thrust. Secondary parameters representing simple feedback gains were subsequently added. Results were surprising for a simple system with basically linear aerodynamics. Periodic branches arising from the loss of pitch stability or associated with a resonance altitude are routinely found with significant amplitude, and periods on the order of an elliptical orbit's period for a given geocentric radius. Rotational states generally had sub-oscillations of greater frequency. GRA

N91-21119# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.

VORTEX BURSTING OVER A UNIT AREA ASPECT RATIO DELTA WING USING VORTEX PANELING METHODS M.S. Thesis

Donald A. Lorey Dec. 1990 77 p
(AD-A231028; AFIT/GAE/ENY/90D-14) Avail: NTIS HC/MF A05 CSCL 01/1

A unit aspect ratio delta wing is analyzed to determine if an unsteady vortex panel method can calculate the vortex bursting of the vortex developed along the leading edge. A two-dimensional vortex panel method is used to investigate wake splitting schemes of the vortex cores that comprise the vortex sheet, or wake. The worthier of the splitting methods is later implemented into the three-dimensional wake. The weighting values of the Kutta equations are investigated for the leading edges, and are determined to be problem specific. An alternative approach to management of the wake data is presented and implemented. The delta wing is then analyzed for 20.5 and 30 deg angle of attack. The panel method produced a perturbation and enlargement in the wake at two thirds chord position over the wing at 30 deg angle of attack, indicative of vortex breakdown. However, a qualitative comparison with the results of the 20.5 deg angle of attack calculation negates this conclusion. Vortex bursting was not evident over the wing at 30 deg angle of attack. GRA

N91-21120# Nielsen Engineering and Research, Inc., Mountain View, CA.

PREDICTION OF UNSTEADY TRANSONIC SEPARATED FLOW FOR MISSILE APPLICATIONS Final Report, 1 Jul. 1987 - 15 Oct. 1990

P. Reisenthel and D. Nixon 20 Nov. 1990 121 p
(Contract DAAL03-87-C-0008)
(AD-A231259; NEAR-TR-418; ARO-24788.7-EG) Avail: NTIS HC/MF A06 CSCL 20/4

A theory was developed to treat flow separation and related vortex effects in unsteady transonic flow around slender bodies. This theory involves the simultaneous solution of a modified Transonic Small Disturbance Equation, a kinematic vector potential equation, and a 3-D transport equation for the streamwise vorticity. In this theory, flow separation is modeled using normal vorticity jets placed along the separation line. The location and strength of the separating vorticity was determined from empirical criteria. A steady version of the theory was implemented using a considerably developed form of the TWING potential code, while the unsteady implementation was performed using an enhanced version of the computational aeroelasticity program (CAP-TSD). A critical result was that a second order correction to the pressure, namely, the inclusion of the rotational streamwise velocity component, is necessary to account for the tilting of vortices away from the body axis. Time-accurate computations of subsonic, transonic, and supersonic flow show that it is possible to compute the flow around realistic angle of attack missile configurations, thus showing considerable potential for aeroelastic computations and unsteady aerodynamics. Results of 2-D Navier-Stokes calculations indicate that several key aspects characterizing the time-dependent behavior of boundary layer separation may be accurately predicted using indicial theory. These results demonstrate the possibility of significant phase lags and fluctuation overshoots of the normal vorticity flux at separation. GRA

03 AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents.

For related information see also *16 Space Transportation* and *85 Urban Technology and Transportation.*

N91-21121*# Battelle Columbus Labs., Mountain View, CA.
NON-AIRBORNE CONFLICTS: THE CAUSES AND EFFECTS OF RUNWAY TRANSGRESSIONS
Richard J. Tarrel Sep. 1985 86 p
(Contract NAS2-11934)
(NASA-CR-177372; NAS 1.26:177372) Avail: NTIS HC/MF A05 CSCL 01C

The 1210 ASRS runway transgression reports are studied and expanded to yield descriptive statistics. Additionally, a one of three subset was studied in detail for purposes of evaluating the causes, risks, and consequences behind trangression events. Occurrences are subdivided by enabling factor and flight phase designations. It is concluded that a larger risk of collision is associated with controller enabled departure transgressions over all other categories. The influence of this type is especially evident during the period following the air traffic controllers' strike of 1981. Causal analysis indicates that, coincidentally, controller enabled departure transgressions also, show the strongest correlations between causal factors. It shows that departure errors occur more often when visibility is reduced, and when multiple takeoff runways or intersection takeoffs are employed. In general, runway transgressions attributable to both pilot and controller errors arise from three problem areas: information transfer, awareness, and spatial judgement. Enhanced awareness by controllers will probably reduce controller enabled incidents. Author

N91-21122# Dayton Univ., OH. Structural Integrity Div.
STUDY OF BIRD INGESTIONS INTO SMALL INLET AREA AIRCRAFT TURBINE ENGINES Final Report, May 1987 - Apr. 1989
Joseph P. Martino, Donald A. Skinn, and Joseph J. Wilson Dec. 1990 93 p
(Contract DTFA03-88-C-00024)
(DOT/FAA/CT-90/13; UDR-TR-90-23) Avail: NTIS HC/MF A05

Summarized here are two years of data collection on the ingestion of birds into small inlet area aircraft turbine engines. A total of 16.1 million engine operations were flown by aircraft equipped with the small inlet area engines (ALF502, TFE731, TPE331, and JT15D) included in this study. This includes 24 months of operations for the first three engines and 12 months of operations for the last engine. A total of 210 engine ingestion events were reported during the two years of data collection. These events were analyzed to determine the degree of probability of ingestion, probability of degree of damage, probability of ingestion by phase of flight, and frequency of ingestion by geographic area. Author

N91-21123# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany, F.R.). Abt. Wolkenphysik.
ANALYSIS OF THREE ICING TEST FLIGHTS REACHING THE AIRCRAFT-REFERRED ICING DEGREE SEVERE
Hans-Eberhard Hoffmann and Johann Demmel Aug. 1990 118 p In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-1254)
(DLR-FB-90-34; ISSN-0171-1342; ETN-91-99031) Avail: NTIS HC/MF A06; DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 45.50 DM

Three test flights in icing conditions where the aircraft referred icing degree severe is reached are discussed. One was in the range of a high pressure area, the others were in the range of warm fronts. In the area of the pneumatic deicing boots, the deicing was totally ineffective or incomplete. The cloud paths in the range of the warm fronts were only 0.1 or 0.3 times the cloud path in the range of a high pressure area, for obtaining the maximum icing characteristics (extension roughness, mass) of the high pressure area because of the considerably higher value of the median volume diameter in the range of the warmfronts. ESA

N91-21124# Naval Environmental Prediction Research Facility, Monterey, CA.
IMPACT OF ICING ON UNMANNED AERIAL VEHICLE (UAV) OPERATIONS
Richard A. Siquig 1990 8 p
(AD-A231191) Avail: NTIS HC/MF A02 CSCL 01/3

Clouds with supercooled liquid water constitute a significant aviation hazard because of the potential risk of aircraft icing. Icing reduces rate of lift, rate of climb, and fuel efficiency while increasing drag, stalling speed, weight, and power requirements. Indirectly, icing also exacts a penalty because on board icing detection/removal equipment may be required at the expense of other payload and because icing conditions may restrict launch/recovery or possible flight paths. All of these considerations can be of increased importance for unmanned aerial vehicle (UAV) operations because of the unique design features of some UAVs and because of the extra burden placed on autonomous control systems. Therefore, UAV operations will require strong icing forecast support and remote icing detector systems at the vehicle bases and possibly on the vehicles themselves. High flying long endurance UAVs will be able to fly above icing levels but are at special risk in ascending/descending through icing layers due to the degradation icing causes to the highly optimized wing shape of such vehicles. Low flying short endurance vehicles do not have such sensitive wing shapes but may not be able to fly above all icing layers. The high flyers may be able to ascend/descend over their bases and thus require remote sensors only at the bases, whereas low flyers may require on board sensors when they are out of base sensor range. GRA

04 AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

For related information see also *17 Space Communications, Spacecraft Communications, Command and Tracking* and *Communications and Radar.*

N91-21125# New Mexico State Highway and Transportation Dept., Santa Fe.
ASSESSMENT OF THE ABSOLUTE ACCURACY OF LONG-BASELINE KINEMATIC GPS POSITIONING OF A MOVING VEHICLE
Thomas Henderson and M. Leach Sep. 1990 22 p Prepared in cooperation with Texas Univ., Austin Sponsored by FHA
(PB91-129379; FHWA/HPR/NM-89-04) Avail: NTIS HC/MF A03 CSCL 17G

An experiment was conducted in Oct. 1989 to assess the accuracy of kinematic Global Positioning System (GPS) in positioning a moving rail car over baselines of up to 100 miles. High order WGS-84 stations were used to reference the kinematic survey. The experiment compared carefully determined WGS-84 positions of test points along the center-line of a railroad test track with corresponding positions observed by a roving train-mounted GPS antenna as it passed over the test points moving at 60 miles per hour. Three-dimensional agreement at the sub 25 centimeter level was achieved with consistent precision of better than 5 centimeters. GRA

N91-21126# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
AVHRR/NOAA IMAGERY NAVIGATION FROM THE GEODETIC REFERENCE MATRIX: STUDIES AND EVALUATIONS [NAVEGACAO DE IMAGENS AVHRR/NOAA A PARTIR DA MATRIZ DE REFERENCIA GEODESIA: ESTUDOS E AVALIACOES]

Keiko Tanaka and Jose Luis deOliveira Dec. 1990 8 p In PORTUGUESE; ENGLISH summary Presented at the 6th Brazilian Symposium on Remote Sensing, Manaus, Brazil, 24-29 Jun. 1990 (INPE-5216-PRE/1672) Avail: NTIS HC/MF A02

Using geographic reference matrixes, a comparative study of AVHRR/NOAA imagery navigation is presented. The matrix elements of sample points are generated using a physics-mathematic formulation developed by Medeiros and Tanaka (1986). The coordinate (latitude, longitude) of intermediate points were determined using two different interpolation methods: linear and Lagrange. The precision of these methods was evaluated comparing with the navigation results from the physics-mathematics formulation. The computer time to run these methods was analyzed also. Author

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

For related information see also *18 Spacecraft Design, Testing and Performance* and *39 Structural Mechanics.* For land transportation vehicles see *85 Urban Technology and Transportation.*

N91-21127*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

SPAN REDUCTION EFFECTS ON THE FLUTTER CHARACTERISTICS OF ARROW-WING SUPERSONIC TRANSPORT CONFIGURATIONS

Donald F. Keller and Ellen Parker Bullock 26 Dec. 1990 55 p (NASA-TP-3077; L-16807; NAS 1.60:3077) Avail: NTIS HC/MF A04 CSCL 01C

An experimental and analytical investigation was initiated to determine the effect of span reduction on the flutter characteristics of several arrow-wing supersonic transport (SST) configurations. The model was a semispan wing with the experimental flutter results obtained in the Langley Transonic Dynamics Tunnel over a Mach number range from 0.60 to 1.20. Two flow-through nacelles were used to represent wing-mounted engines. A wing fin was mounted either vertically or canted outboard at 45 degrees. Portions of the wingtip were removed in increments parallel to the root chord to provide reductions un wing span of 10, 20, and 30 percent. Reducing the wing span increased the flutter dynamic pressure for all configurations tested. The largest increases in the flutter dynamic pressure were observed for the configurations with nacelles. Although reducing the span had little effect on flutter-speed index for the wing only and the wing with fin configuration, and increase was observed for the configurations with nacelles, particularly in the high transonic region. The flutter analysis, which generally showed the same trends as the experimental results, was consistently more conservative in the low transonic region than in the high transonic region. Author

N91-21128# Naval Aerospace Medical Research Lab., Pensacola, FL.

PREDICTING F-14 AIR COMBAT MANEUVERING (ACM) PERFORMANCE USING AN AUTOMATED BATTERY OF COGNITIVE/PSYCHOMOTOR TESTS Interim Report, Mar. 1988 - Mar. 1989

R. N. Shull and G. R. Green Jun. 1990 12 p (AD-A228593; NAMRL-1356) Avail: NTIS HC/MF A03 CSCL 01/3

Some studies have suggested the possibility of predicting operational performance in fleet aviation environments. The current report concerns the use of an automated performance-based test battery, involving cognitive and psychomotor functioning, to predict the operational performance of fighter pilots. A group of jet pilots completing air combat maneuvering (ACM) training in the F-14 were tested on this battery. The few significant correlations found between the test measures and ACM performance measures were illogically patterned and of insufficient quantity or strength to establish that such a battery would reliably predict ACM performance. This could have been due to the homogeneous nature of the subject group in terms of pilot skills and abilities. Given these results, this particular test battery would probably not be useful in the prediction of flight performance at such a late stage of training as ACM, but it might predict flight performance in earlier training. GRA

N91-21129 ESDU International Ltd., London (England).

LIFT AND ROLLING MOMENT DUE TO SPOILERS ON WINGS AT SUBSONIC SPEEDS Abstract Only

Nov. 1990 25 p (ESDU-90030; ISBN-0-85679-756-1; ISSN-0141-397X) Avail: ESDU

ESDU 90030 considers the flat plate (deflecting in a plane normal to the aerofoil surface) and flap (pivoting about a hinge on the airfoil surface) types of unvented spoilers with or without porosity on the upper surface of a wing with trailing-edge flaps undeployed. It discusses the flow behavior with variation of spoiler chordwise position and deflection and illustrates the effect on wing lift-curve slope and shape. By correlating experimental data drawn from the literature, a method is developed for predicting the lift decrement in two-dimensional flow which is then corrected to three dimensions (by scaling by the wing lift-curve slop predicted using ESDU 70011) and for part span effects by means of an empirically derived factor. The rolling moment is predicted assuming the lift decrement acts at spoiler mid-span and correcting the moment arm for wing taper and for lift carry-over beyond the physical extent of the spoiler at either end. The method allows for any form of porosity (face perforations, hinge-line gaps, spoiler segmentation or edge castellation) up to 0.25 of the spoiler area. Spoiler locations from 0.4 chord to the trailing-edge are covered for spoiler deflections (defined as height as a fraction of chord where height is measured above the aerofoil surface for the plate type or above the pivot for the flap type) from 0.04 to 0.15 where the lower limit is set by the onset of Reynolds number effects. The experimental data that was used covered a wide range of straight-tapered wing planforms with aspect ratio 3 and above, taper ratios from 0.4 to 1 and mid-chord sweep up to 30 degrees for Mach numbers up to 0.7. Behavior is affected by wing angle of attack and limits of applicability for both minimum and maximum incidence are suggested. Sketches show plots of predictions by the method against experimental results; predictions lie within 0.05 for lift coefficient and within 0.007 for rolling moment coefficient for 75 percent of the data. ESDU

N91-21130# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.). Abt. Mathematische Verfahren und Datentechnik.

IDENTIFICATION OF THE AERODYNAMIC MODEL OF THE DLR RESEARCH AIRCRAFT ATTAS FROM FLIGHT TEST DATA

Ravindra Jategaonkar Aug. 1990 102 p Prepared in cooperation with Technische Univ. Brunswick, Fed. Republic of Germany (DLR-FB-90-40; ISSN-0171-1342; ETN-91-99035) Avail: NTIS HC/MF A06; DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 37 DM

Determination of aerodynamic characteristics of the Advanced Technologies Testing Aircraft System (ATTAS) Aircraft from flight test data is addressed. The details of flight tests carried out for this purpose, together with the results of consistency checking of the onboard recorded data and identification of the aerodynamic model are reported. The data checking is based on the kinematic equations of aircraft motion. The estimation of aerodynamic derivatives is carried out from the coupled equations of aircraft motion pertaining to the longitudinal and lateral directional motion. For both of these purposes the maximum likelihood estimation method is employed. The details of mass characterisrics data, such as position of center of gravity and moments of inertia, are provided along with other aircraft installation dependent data required for parameter estimation. The results of kinematic consistency checking, the aerodynamic derivatives at typical flight conditions, and attempts to derive a combined model valid over a

wider range of speed variations are reported. Such an extended aerodynamic model can be incorporated in the ground based simulation of the test aircraft. ESA

N91-21131*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
SIMULATION OF NAP-OF-THE-EARTH FLIGHT IN HELICOPTERS
Gregory W. Condon Feb. 1991 20 p Presented at the AGARD 50th Symposium on Computer Aided System Design and Simulation, Izmir, Turkey, 22-25 May 1990 Previously announced as N91-15744
(NASA-TM-102830; A-90178; NAS 1.15:102830) Avail: NTIS HC/MF A03 CSCL 01C

NASA-Ames along with the U.S. Army has conducted extensive simulation studies of rotorcraft in the nap-of-the-Earth (NOE) environment and has developed facility capabilities specifically designed for this flight regime. The experience gained to date in applying these facilities to the NOE flight regime are reported along with the results of specific experimental studies conducted to understand the influence of both motion and visual scene on the fidelity of NOE simulation. Included are comparisons of results from concurrent piloted simulation and flight research studies. The results of a recent simulation experiment to study simulator sickness in this flight regime is also discussed. Author

N91-21132*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
A SIMPLE, ANALYTICAL, AXISYMMETRIC MICROBURST MODEL FOR DOWNDRAFT ESTIMATION
Dan D. Vicroy Feb. 1991 13 p Sponsored in part by FAA
(NASA-TM-104053; NAS 1.15:104053) Avail: NTIS HC/MF A03 CSCL 01C

A simple analytical microburst model was developed for use in estimating vertical winds from horizontal wind measurements. It is an axisymmetric, steady state model that uses shaping functions to satisfy the mass continuity equation and simulate boundary layer effects. The model is defined through four model variables: the radius and altitude of the maximum horizontal wind, a shaping function variable, and a scale factor. The model closely agrees with a high fidelity analytical model and measured data, particularly in the radial direction and at lower altitudes. At higher altitudes, the model tends to overestimate the wind magnitude relative to the measured data. Author

N91-21133# Army Natick Labs., MA.
EVALUATION OF AN ALTERNATIVE ROTORCRAFT CARGO LOWERING DEVICE FOR THE DELIVERY OF 500-lb AMMUNITION LOADS Final Report, Oct. 1987 - Aug. 1989
Glenn Doucet Dec. 1990 40 p
(AD-A230995; NATICK/TR-91/010) Avail: NTIS HC/MF A03 CSCL 15/5

The focus of this analysis was to investigate a commercial lowering device called the Sky Genie for rotorcraft delivery of 500-lb ammunition loads. This item, similar to the presently used cargo and personnel rappelling device, uses the friction of rope on metal to control the payload's descent. Reduction in payload descent time, which translates into improved troop and aircraft survivability, was sought. This report describes the functional and operational tests performed on this item. Based on these tests, it was concluded that the Sky Genie represents an effective, predictable means of delivering up to 500-lb payloads from altitudes up to 100 ft with no user input once the load leaves the rotorcraft. GRA

06 AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

For related information see also *19 Spacecraft Instrumentation* and *35 Instrumentation and Photography.*

N91-21134*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
SUPPRESSION OF BIODYNAMIC INTERFERENCE IN HEAD-TRACKED TELEOPERATION
S. Lifshitz, S. J. Merhav, A. J. Grunwald, G. E. Tucker, and M. B. Tischler (Army Aviation Systems Command, Moffett Field, CA.) Jan. 1991 15 p Presented at the 16th European Rotorcraft Forum, Glasgow, Scotland, 18-20 Sep. 1990
(NASA-TM-103833; A-91058; NAS 1.15:103833; AVSCOM-TR-90-A-005) Avail: NTIS HC/MF A03 CSCL 01D

The utility of helmet-tracked sights to provide pointing commands for teleoperation of cameras, lasers, or antennas in aircraft is degraded by the presence of uncommanded, involuntary heat motion, referred to as biodynamic interference. This interference limits the achievable precision required in pointing tasks. The noise contributions due to biodynamic interference consists of an additive component which is correlated with aircraft vibration and an uncorrelated, nonadditive component, referred to as remnant. An experimental simulation study is described which investigated the improvements achievable in pointing and tracking precision using dynamic display shifting in the helmet-mounted display. The experiment was conducted in a six degree of freedom motion base simulator with an emulated helmet-mounted display. Highly experienced pilot subjects performed precision head-pointing tasks while manually flying a visual flight-path tracking task. Four schemes using adaptive and low-pass filtering of the head motion were evaluated to determine their effects on task performance and pilot workload in the presence of whole-body vibration characteristic of helicopter flight. The results indicate that, for tracking tasks involving continuously moving targets, improvements of up to 70 percent can be achieved in percent on-target dwelling time and of up to 35 percent in rms tracking error, with the adaptive plus low-pass filter configuration. The results with the same filter configuration for the task of capturing randomly-positioned, stationary targets show an increase of up to 340 percent in the number of targets captured and an improvement of up to 24 percent in the average capture time. The adaptive plus low-pass filter combination was considered to exhibit the best overall display dynamics by each of the subjects. Author

N91-21135*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
DIGITAL SIGNAL CONDITIONING FOR FLIGHT TEST INSTRUMENTATION
Glenn A. Bever Mar. 1991 81 p Sponsored by AGARD Flight Mechanics Panel, Flight Test Techniques Working Group
(NASA-TM-101739; H-1695; NAS 1.15:101739; AGARDograph-160) Avail: NTIS HC/MF A05 CSCL 01D

An introduction to digital measurement processes on aircraft is provided. Flight test instrumentation systems are rapidly evolving from analog-intensive to digital intensive systems, including the use of onboard digital computers. The topics include measurements that are digital in origin, as well as sampling, encoding, transmitting, and storing data. Particular emphasis is placed on modern avionic data bus architectures and what to be aware of when extracting data from them. Examples of data extraction techniques are given. Tradeoffs between digital logic families, trends in digital development, and design testing techniques are discussed. An introduction to digital filtering is also covered. Author

N91-21136# General Accounting Office, Washington, DC. Information Management and Technology Div.
EMBEDDED COMPUTERS: NAVY'S APPROACH TO DEVELOPING PATROL AIRCRAFT AVIONICS SYSTEM TOO RISKY
Sep. 1990 15 p

(AD-A230868; GAO/IMTEC-90-79) Avail: NTIS HC/MF A03 CSCL 15/5

The Navy plans to buy complex avionics computer systems, and related communications equipment and sensors, for submarine patrol aircraft. This acquisition, designated the Update IV Program, is intended to provide the Navy with the capability to locate, identify, and attack the expected threat of more quiet submarines. This report reviews the Department of Defense's acquisition of computer systems embedded in weapon systems. Objectives were to determine whether (1) the Navy plans to adequately test the avionics computer systems before buying them and (2) Navy management oversight of these computer systems has occurred. The Navy is taking a high risk approach in acquiring a new complex computer-based avionics system for its patrol aircraft. Although the Navy originally planned to thoroughly test this system before buying more than four, program delays led to the Navy to postpone complete testing. This clearly contrary to (1) Defense policies which, when followed, should be effective in mitigating computer system development risks and (2) the principle of fly before you buy.

GRA

07 AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxilliary power plants for aircraft.

For related information see also *20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *44 Energy Production and Conversion.*

N91-21137*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

INTEGRATED FLIGHT/PROPULSION CONTROL SYSTEM DESIGN BASED ON A DECENTRALIZED, HIERARCHICAL APPROACH

Duane Mattern, Sanjay Garg (Sverdrup Technology, Inc., Brook Park, OH.), and Randy Bullard 1989 41 p Presented at the Guidance, Navigation and Control Conference, Boston, MA, 14-16 Aug. 1989; sponsored by AIAA Previously announced in IAA as A89-53301

(NASA-TM-103678; E-5895; NAS 1.15:103678; AIAA-89-3519) Avail: NTIS HC/MF A03 CSCL 21E

A sample integrated flight/propulsion control system design is presented for the piloted longitudinal landing task with a modern, statistically unstable fighter aircraft. The design procedure is summarized. The vehicle model used in the sample study is described, and the procedure for partitioning the integrated system is presented along with a description of the subsystems. The high-level airframe performance specifications and control design are presented and the control performance is evaluated. The generation of the low-level (engine) subsystem specifications from the airframe requirements are discussed, and the engine performance specifications are presented along with the subsystem control design. A compensator to accommodate the influence of airframe outputs on the engine subsystem is also considered. Finally, the entire closed loop system performance and stability characteristics are examined. Author

N91-21138*# Sverdrup Technology, Inc., Brook Park, OH.

A MODAL AEROELASTIC ANALYSIS SCHEME FOR TURBOMACHINERY BLADING M.S. Thesis - Case Western Reserve Univ. Final Report

Todd E. Smith Mar. 1991 132 p

(Contract NAS3-25266)

(NASA-CR-187089; E-6081; NAS 1.26:187089) Avail: NTIS HC/MF A07 CSCL 21E

An aeroelastic analysis is developed which has general application to all types of axial-flow turbomachinery blades. The approach is based on linear modal analysis, where the blade's dynamic response is represented as a linear combination of contributions from each of its in-vacuum free vibrational modes. A compressible linearized unsteady potential theory is used to model the flow over the oscillating blades. The two-dimensional unsteady flow is evaluated along several stacked axisymmetric strips along the span of the airfoil. The unsteady pressures at the blade surface are integrated to result in the generalized force acting on the blade due to simple harmonic motions. The unsteady aerodynamic forces are coupled to the blade normal modes in the frequency domain using modal analysis. An iterative eigenvalue problem is solved to determine the stability of the blade when the unsteady aerodynamic forces are included in the analysis. The approach is demonstrated by applying it to a high-energy subsonic turbine blade from a rocket engine turbopump power turbine. The results indicate that this turbine could undergo flutter in an edgewise mode of vibration. Author

N91-21139*# Institute for Computer Applications in Science and Engineering, Hampton, VA.

PRELIMINARY CALIBRATION OF A GENERIC SCRAMJET COMBUSTOR Final Interim Report No. 16

P. A. Jacobs, R. G. Morgan, R. C. Rogers, M. Wendt, C. Brescianini, A. Paull, and G. Kelly (Queensland Univ., Saint Lucia, Australia) Mar. 1991 32 p Sponsored by Australian Research Council

(Contract NAS1-18605; NAGw-674)

(NASA-CR-187539; NAS 1.26:187539; ICASE-16) Avail: NTIS HC/MF A03 CSCL 21E

The results of a preliminary investigation of the combustion of hydrogen fuel at hypersonic flow conditions are provided. The tests were performed in a generic, constant-area combustor model with test gas supplied by a free-piston-driven reflected-shock tunnel. Static pressure measurements along the combustor wall indicated that burning did occur for combustor inlet conditions of P(static) approximately equal to 19kPa, T(static) approximately equal to 1080 K, and U approximately equal to 3630 m/s with a fuel equivalence ratio approximately equal to 0.9. These inlet conditions were obtained by operating the tunnel with stagnation enthalpy approximately equal to 8.1 MJ/kg, stagnation pressure approximately equal to 52 MPa, and a contoured nozzle with a nominal exit Mach number of 5.5. Author

N91-21140*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

INTEGRATED FLIGHT/PROPULSION CONTROL DESIGN FOR A STOVL AIRCRAFT USING H-INFINITY CONTROL DESIGN TECHNIQUES

Sanjay Garg and Peter J. Ouzts 1991 33 p Presented at the American Control Conference, Boston, MA, 26-28 Jun. 1991; sponsored in part by the American Automatic Control Council

(NASA-TM-104340; E-6113; NAS 1.15:104340) Avail: NTIS HC/MF A03 CSCL 21E

Results are presented from an application of H-infinity control design methodology to a centralized integrated flight propulsion control (IFPC) system design for a supersonic Short Takeoff and Vertical Landing (STOVL) fighter aircraft in transition flight. The emphasis is on formulating the H-infinity control design problem such that the resulting controller provides robustness to modeling uncertainties and model parameter variations with flight condition. Experience gained from a preliminary H-infinity based IFPC design study performed earlier is used as the basis to formulate the robust H-infinity control design problem and improve upon the previous design. Detailed evaluation results are presented for a reduced order controller obtained from the improved H-infinity control design showing that the control design meets the specified nominal performance objectives as well as provides stability robustness for variations in plant system dynamics with changes in aircraft trim speed within the transition flight envelope. A controller scheduling technique which accounts for changes in plant control effectiveness with variation in trim conditions is developed and off design model performance results are presented. Author

N91-21141# Arnold Engineering Development Center, Arnold Air Force Station, TN.
EVALUATION OF AIR INJECTION IN A SUDDEN EXPANSION DIFFUSER FOR REAL-TIME AFTERBURNING APPLICATION Final Report, 22 Jan. - 5 Apr. 1989
S. E. Stephens Jan. 1991 87 p Prepared in cooperation with Sverdrup Technology, Inc., Arnold AFB, TN
(AD-A230850; AEDC-TR-90-29) Avail: NTIS HC/MF A05 CSCL 21/2

Altitude testing of advanced hydrogen-fueled propulsion systems will require techniques to deal with unburned hydrogen in the engine exhaust stream. One approach is real-time afterburning. This approach would inject oxidizer in the test facility exhaust diffuser and burn off the excess hydrogen before it reached any facility machinery. A combined experimental and computational study was conducted to evaluate the feasibility of this approach. The experimental study tested a sudden expansion diffuser with injection both upstream and downstream of the step. Engine air was delivered through either a Mach 3.0 or 0.8 nozzle The acquired data evaluated mixing of the nonreacting streams using measured temperatures and a Crocco relationship. Wall and pitot pressures were used to evaluate diffuser performance. The PARC computer programs was used to predict the flow field two test conditions. The results showed that good mixing can be obtained with the configuration at penalty of loss in maximum diffuser pressure rise. The PARC program did an excellent job of predicting the flow-field pressures and shock structure; however, it was less satisfactory for predicting mixing based on temperature distribution. GRA

N91-21142# Arnold Engineering Development Center, Arnold Air Force Station, TN.
NONINTRUSIVE NITRIC OXIDE DENSITY MEASUREMENTS IN THE NASA LANGLEY ARC-HEATED SCRAMJET ENGINE TEST FACILITY Final Report, 1 Apr. 1988 - 1 Jun. 1990
R. P. Howard, K. L. Dietz, and W. K. McGregor Jan. 1991 69 p
(Contract F40600-85-C-0026)
(AD-A231260; AEDC-TR-90-26) Avail: NTIS HC/MF A04 CSCL 21/5

A nitric oxide (NO) resonance absorption technique was used to determine average path integrated NO number densities through the expanded flow of the NASA Langley Arc Heated Scramjet Test Facility. The mole fraction ranged from 0.016 to 0.019 (with a 20-pct uncertainty) for static temperatures from 186 to 320 K. Absorption was observed in the NO gamma (0,1) band that could not be accounted for at the static flow conditions if the NO were at vibrational equilibrium. Using the (0,1) transmittance measurement and the number density calculated from the (0,0) transmittance measurement, vibrational temperatures ranging from 534 to 919 K were calculated with a minimum uncertainty from -15 to 21 percent. A nonequilibrium vibrational temperature, 1,100 K, was calculated from a 1-D kinetic (ODK) chemistry code compared to the 919 K determine from the measurement. Within the range of uncertainties of the (0,1) absorption measurements, the corresponding NO radiative transfer code calculations of vibrational temperature, and the range of uncertainties of the ODK code calculations, there is good agreement in the resulting vibrational temperature. GRA

N91-21143# Wright Research Development Center, Wright-Patterson AFB, OH.
AN EXPERIMENTAL STUDY OF EXIT FLOW PATTERNS IN A MULTISTAGE COMPRESSOR IN ROTATING STALL Final Technical Report, Jun. 1989 - May 1990
Steven E. Gorrell Nov. 1990 146 p
(AD-A231353; WRDC-TR-90-2083) Avail: NTIS HC/MF A07 CSCL 13/7

High-response pressure measurements of a high-speed, 10-stage, axial-flow compressor operating in rotating stall are analyzed. Procedures used to digitize analog voltages and calibrate pressure transducers are presented. From total and static pressures measured at the exit of the test compressor, stall cell Mach number distributions are calculated and used to study the effects of discharge throttle levels and variable vane changes on the 10th-stage rotating stall cells. Results indicate that significant transition zones exist between the reverse flow and peak Mach number of the stall cell cycle. Since the axial Mach numbers of the stall cell cycle are constantly changing, the amount of leading and trailing edge transition zones and fully unstalled flow zones are not easily defined. A method is devised to approximate the different flow zone ranges and correlate them to in-stall pressure characteristic behavior of the 10th stage of the test compressor. Changes in the time-averaged pressure characteristics are found to correlate with changes in the rotating stall flow zones. A lower pressure coefficient appears to correspond to an increase in ratio of trailing to leading edge transition zone size and the average transition zone size. Results also suggest that recovery hysteresis in the test compressor is characterized by reverse flow in the rotating stall cell. GRA

08 AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

For related information see also *05 Aircraft Design, Testing and Performance.*

N91-21144*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
HOT-BENCH SIMULATION OF THE ACTIVE FLEXIBLE WING WIND-TUNNEL MODEL
Carey S. Buttrill and Jacob A. Houck Nov. 1990 14 p Presented at the AIAA Flight Simulation Technologies Conference, Dayton, OH, 17-19 Sep. 1990 Previously announced in IAA as A91-16678
(NASA-TM-102758; NAS 1.15:102758; AIAA-90-3121) Avail: NTIS HC/MF A03 CSCL 01C

Two simulations, one batch and one real-time, of an aeroelastically-scaled wind-tunnel model were developed. The wind-tunnel model was a full-span, free-to-roll model of an advanced fighter concept. The batch simulation was used to generate and verify the real-time simulation and to test candidate control laws prior to implementation. The real-time simulation supported hot-bench testing of a digital controller, which was developed to actively control the elastic deformation of the wind-tunnel model. Time scaling was required for hot-bench testing. The wind-tunnel model, the mathematical models for the simulations, the techniques employed to reduce the hot-bench time-scale factors, and the verification procedures are described. IAA

N91-21145# Norwegian Defence Research Establishment, Kjeller.
SPECIFICATION OF THE AUTONOMOUS MISSILE GUIDANCE PROBLEM FOR THE TA11 PROCESSOR. VOLUME 4: PROCESSOR MINI-SPEC
Einar Oestevold, Idar Dyrdal, Stein Grinaker, Eilert Heyerdahl, Hans C. Palm, and Geir A. Storhaug 20 Sep. 1990 54 p
(FFI-90/4005-Vol-4; ISSN-0802-2437; ETN-91-99055) Avail: NTIS HC/MF A04

The algorithm specification work carried out as a basis for the construction of the Independent European Program Group/Technical Area (TA) 11 processor is presented in nine volumes. This is a general image processor developed for the TA11 project: a cooperative research program on intelligent target tracking and acquisition techniques for guided missiles. Participating nations are the U.K. and Norway. The first part of the specification is a general structured analysis of the entire autonomous missile guidance problem where Yourdon/DeMarco formalism is used. This analysis has three parts; a data flow diagram depicting the structure of the problem; a data dictionary specifying data flows between processes; and a processor minispec describing all basic (terminal) processes involved. The second part of the specification is aimed at deriving implementation independent numbers for the complexity

of processes and for data volumes and rates. Since the TA11 processor is to be a general image processor, complexity is given by a detailed specification of a wide range of example algorithms. To derive the overall (simultaneous) complexity, operational modes identifying concurrent processes are defined. The different processes are presented as a part of the general specification of the autonomous missile guidance problem. ESA

N91-21146# Norwegian Defence Research Establishment, Kjeller.
SPECIFICATION OF THE AUTONOMOUS MISSILE GUIDANCE PROBLEM FOR THE TA11 PROCESSOR. VOLUME 6: SPECIFICATION MODE 16, N
Einar Oestevold, Idar Dyrdal, Stein Grinaker, Eilert Heyerdahl, Hans C. Palm, and Geir A. Storhaug 20 Sep. 1990 28 p
(FFI-90/4005-Vol-6; ISSN-0802-2437; ETN-91-99057) Avail: NTIS HC/MF A03

The algorithm specification work carried out as a basis for the construction of the independent European Program Group/Technical Area (TA) 11 processor is presented in nine volumes. This is a general image processor developed for the TA11 project: a cooperative research program in intelligent target tracking and acquisition techniques for guided missiles. Participating nations are the U.K. and Norway. The first part of the specification is a general structured analysis of the entire autonomous missile guidance problem where Yourdon/DeMarco formalism is used. This analysis has three parts; a data flow diagram depicting the structure of the problem; a data dictionary specifying data flows between processes; and a processor minispec describing all basic (terminal) processes involved. The second part of the specifications is aimed at deriving implementation independent numbers for the complexity of processes and for data volumes and rates. Since the TA11 processor is to be a general image processor, complexity is given by a detailed specification of a wide range of example algorithms. To derive the overall (simultaneous) complexity, operational modes identifying concurrent processes are defined. Quantitative specifications relating to navigation are given. ESA

N91-21147# Norwegian Defence Research Establishment, Kjeller.
SPECIFICATION OF THE AUTONOMOUS MISSILE GUIDANCE PROBLEM FOR THE TA11 PROCESSOR. VOLUME 7: SPECIFICATION MODE 29, N + A + T + H
Einar Oestevold, Idar Dyrdal, Stein Grinaker, Eilert Heyerdahl, Hans C. Palm, and Geir A. Storhaug 20 Sep. 1990 18 p
(FFI-90/4005-Vol-7; ISSN-0802-2437; ETN-91-99058) Avail: NTIS HC/MF A03

The algorithm specification work carried out as a basis for the construction of the Independent European Program Group/Technical Area (TRA) 11 processor is presented in nine volumes. This is a general image processor developed for the TA11 project: a cooperative research program on intelligent target tracking and acquisition techniques for guided missiles. Participating nations are the U.K. and Norway. The first part of the specification is a general structured analysis of the entire autonomous missile guidance problem where Yourdon/DeMarco formalism is used. This analysis has three parts: a data flow diagram depicting the structure of the problem; a data dictionary specifying data flows between processes; and a processor minispec describing all basic (terminal) processes involved. The second part of the specification is aimed at deriving implementation independent numbers for the complexity of processes and for data volumes and rates. Since the TA11 processor is to be a general image processor, complexity is given by a detailed specification of a wide range of example algorithms. To derive the overall (simultaneous) complexity, operational modes identifying concurrent processes are defined. Quantitative specifications relating to acquisition, tracking, aim point analysis and navigation are presented. ESA

N91-21148# Norwegian Defence Research Establishment, Kjeller.
SPECIFICATION OF THE AUTONOMOUS MISSILE GUIDANCE PROBLEM FOR THE TA11 PROCESSOR. VOLUME 8: SPECIFICATION MODE 30, N + A + T + B
Einar Oestevold, Idar Dyrdal, Stein Grinaker, Eilert Heyerdahl, Hans C. Palm, and Geir A. Storhaug 20 Sep. 1990 22 p
(FFI-90/4005-Vol-8; ISSN-0802-2437; ETN-91-99059) Avail: NTIS HC/MF A03

The algorithm specification work carried out as a basis for the construction of the Independent European Program Group/Technical Area (TA) 11 processor is presented in nine volumes. This is a general image processor developed for the TA11 project: a cooperative research program on intelligent target tracking and acquisition techniques for guided missiles. Participating nations are the U.K. and Norway. The first part of the specification is a general structured analysis of the entire autonomous missile guidance problem where Yourdon/DeMarco formalism is used. This analysis has three parts: a data flow diagram depicting the structure of the problem; a data dictionary specifying data flows between processes; and a processor minispec describing all basic (terminal) processes involved. The second part of the specification is aimed at deriving implementation independent numbers for the complexity of processes and for data volumes and rates. Since the TA11 processor is to be a general image processor, complexity is given by a detailed specification of a wide range of example algorithms. To derive the overall (simultaneous) complexity, operational modes identifying concurrent processes are defined. Quantitative specifications relating to acquisition, tracking, background analysis, and navigation are presented. ESA

N91-21149*# Systems Technology, Inc., Mountain View, CA.
FULLY AUTOMATIC GUIDANCE AND CONTROL FOR ROTORCRAFT NAP-OF-THE-EARTH FLIGHT FOLLOWING PLANNED PROFILES. VOLUME 1: REAL-TIME PILOTED SIMULATION
Warren F. Clement, Peter J. Gorder, and Wayne F. Jewell Jan. 1991 145 p
(Contract NAS2-12640)
(NASA-CR-177571-Vol-1; NAS 1.26:177571-Vol-1; STI-TR-1254-1) Avail: NTIS HC/MF A07 CSCL 01C

Developing a single-pilot, all-weather nap-of-the-earth (NOE) capability requires fully automatic NOE (ANOE) navigation and flight control. Innovative guidance and control concepts are investigated in a four-fold research effort that: (1) organizes the on-board computer-based storage and real-time updating of NOE terrain profiles and obstacles in course-oriented coordinates indexed to the mission flight plan; (2) defines a class of automatic anticipative pursuit guidance algorithms and necessary data preview requirements to follow the vertical, lateral, and longitudinal guidance commands dictated by the updated flight profiles; (3) automates a decision-making process for unexpected obstacle avoidance; and (4) provides several rapid response maneuvers. Acquired knowledge from the sensed environment is correlated with the forehand knowledge of the recorded environment (terrain, cultural features, threats, and targets), which is then used to determine an appropriate evasive maneuver if a nonconformity of the sensed and recorded environments is observed. This four-fold research effort was evaluated in both fixed-based and moving-based real-time piloted simulations, thereby, providing a practical demonstration for evaluating pilot acceptance of the automated concepts, supervisory override, manual operation, and re-engagement of the automatic system. Volume one describes the major components of the guidance and control laws as well as the results of the piloted simulations. Volume two describes the complete mathematical model of the fully automatic guidance system for rotorcraft NOE flight following planned flight profiles.
Author

N91-21150*# Systems Technology, Inc., Mountain View, CA.
FULLY AUTOMATIC GUIDANCE AND CONTROL FOR ROTORCRAFT NAP-OF-THE-EARTH FLIGHT FOLLOWING PLANNED PROFILES. VOLUME 2: MATHEMATICAL MODEL

Warren F. Clement, Peter J. Gorder, and Wayne F. Jewell Jan. 1991 468 p
(Contract NAS2-12640)
(NASA-CR-177571-Vol-2; NAS 1.26:177571-Vol-2; STI-TR-1254-2)
Avail: NTIS HC/MF A20 CSCL 01C

Developing a single-pilot, all-weather nap-of-the-earth (NOE) capability requires fully automatic NOE (ANOE) navigation and flight control. Innovative guidance and control concepts are investigated in a four-fold research effort that: (1) organizes the on-board computer-based storage and real-time updating of NOE terrain profiles and obstacles in course-oriented coordinates indexed to the mission flight plan; (2) defines a class of automatic anticipative pursuit guidance algorithms and necessary data preview requirements to follow the vertical, lateral, and longitudinal guidance commands dictated by the updated flight profiles; (3) automates a decision-making process for unexpected obstacle avoidance; and (4) provides several rapid response maneuvers. Acquired knowledge from the sensed environment is correlated with the forehand knowledge of the recorded environment (terrain, cultural features, threats, and targets), which is then used to determine an appropriate evasive maneuver if a nonconformity of the sensed and recorded environments is observed. This four-fold research effort was evaluated in both fixed-base and moving-base real-time piloted simulations; thereby, providing a practical demonstration for evaluating pilot acceptance of the automated concepts, supervisory override, manual operation, and re-engagement of the automatic system. Volume one describes the major components of the guidance and control laws as well as the results of the piloted simulations. Volume two describes the complete mathematical model of the fully automatic guidance system for rotorcraft NOE flight following planned flight profiles. GRA

N91-21151# Institut Franco-Allemand de Recherches, Saint-Louis (France).
POSSIBILITIES OF TRAJECTORY MODIFICATION [MOEGLICHKEITEN ZUR FLUGBAHNBEEINFLUSSUNG]
G. Patz, G. Smeets, K. W. Naumann, and H. Ende 23 Jan. 1990 19 p In GERMAN Presented at ONERA, Palaiseau, France, 3 Oct. 1989
(Contract BMVg-T/R-760/K-0007/K-1707)
(ISL-CO-209/90; ETN-91-98983) Avail: NTIS HC/MF A03

The feasibility of some projects for the piloting of flight vehicles by gaseous spoilers and external combustion is studied. Experimental tests were carried out with shock tubes at the flow conditions of self-ignition. A supersonic wind tunnel was used to investigate the formation of combustible mixtures, such as hydrogen/air and acetylene/air, with varied Mach numbers and configurations. Measurements are obtained by Raman diffusion and showed that the mixture formation significantly influences the turbulent flows. ESA

N91-21152# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.). Abt. fuer Drehfluegelflugzeuge.
RESULTS OF THE HHC WIND TUNNEL TESTS, 1986 - 1988
Roland Kube, Gert Lehmann, and Susanne Malke Jun. 1990 120 p In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-1257)
(DLR-FB-90-42; ISSN-0171-1342; ETN-91-99034) Avail: NTIS HC/MF A06; DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 51 DM

The results of two higher harmonic control (HHC) wind tunnel experiments, which included open and closed loop tests, are presented. The rotor test rig, the data acquisition system, the higher harmonic control system, and the calibration method are described, and the achievable accuracy is specified. The illustration of the tests results provides information about the rotor reaction in the case of higher harmonic control inputs and demonstrates the behavior of the implemented controller. ESA

N91-21153# Minnesota Univ., Minneapolis. Dept. of Aerospace Engineering and Mechanics.
EIGENSPACE DESIGN OF HELICOPTER FLIGHT CONTROL SYSTEMS Final Report
William L. Garrard and Eicher Low Nov. 1990 204 p
(Contract DAAL03-86-K-0056)
(AD-A231588; ARO-23422.9-EL) Avail: NTIS HC/MF A10 CSCL 01/3

An eigenstructure based design methodology for helicopter flight control systems is developed and evaluated. A detailed review is provided of the application of multivariable design techniques to helicopter flight control systems, along with a review of applicable handling quality specifications, a description of the mathematical models used, a presentation of the theory of eigenstructure design, application of the theory to a helicopter design problem, and evaluation of the performance and robustness properties of the resulting control laws. GRA

09 RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tubes; and aircraft engine test stands.

For related information see also *14 Ground Support Systems and Facilities (Space).*

N91-21154# National Center for Atmospheric Research, Boulder, CO. Scientific Computing Div.
SURVEY OF NCAR USER NEEDS FOR VISUALIZATION TOOLS. A RESEARCH REPORT OF THE DIGITAL/NCAR JOINT RESEARCH PROJECT
Ray George and Bob Lackman Oct. 1990 43 p Sponsored by NSF, Washington, DC Prepared in cooperation with Digital Research Corp., Boulder, CO
(PB91-115444; NCAR/TN-354+STR) Avail: NTIS HC/MF A03 CSCL 14B

The visualization project within the Scientific Computing Division (SCD) was implemented to bring the latest visualization tools to the atmospheric and oceanographic research communities served by NCSR. The first step toward achieving the goal in the eyes of the Scientific Visualization Group (SVG) of SCD was to try to better understand the status and objectives of current research activities. Toward the end, a number of personal interviews were conducted in the winter of 1989 with selected scientific research groups. Interview topics included: a description of the research; types and extent of data collected and generated; descriptions of data formats and transformations; workstation requirements and experience; evaluations of software currently in use; future needs and requirements in graphic and visualization; visualization support facilities needed; and user interfaces. Five research programs were reviewed which were judged to be representative of the display needs of a substantial portion of the total community. The report is a recording of the interviews and a compilation of the general similarities and differences between the projects and their activities. While each program focuses on a different major area of the science, each has a vital interest in the management and visualization of very large databases. GRA

N91-21155*# Vigyan Research Associates, Inc., Hampton, VA.
DESCRIPTION AND EVALUATION OF AN INTERFERENCE ASSESSMENT FOR A SLOTTED-WALL WIND TUNNEL
William B. Kemp, Jr. Washington Apr. 1991 53 p
(Contract NAS1-18585)
(NASA-CR-4352; NAS 1.26:4352) Avail: NTIS HC/MF A04 CSCL 14B

A wind-tunnel interference assessment method applicable to test sections with discrete finite-length wall slots is described. The method is based on high order panel method technology and uses mixed boundary conditions to satisfy both the tunnel geometry and wall pressure distributions measured in the slotted-wall region. Both the test model and its sting support system are represented

by distributed singularities. The method yields interference corrections to the model test data as well as surveys through the interference field at arbitrary locations. These results include the equivalent of tunnel Mach calibration, longitudinal pressure gradient, tunnel flow angularity, wall interference, and an inviscid form of sting interference. Alternative results which omit the direct contribution of the sting are also produced. The method was applied to the National Transonic Facility at NASA Langley Research Center for both tunnel calibration tests and tests of two models of subsonic transport configurations. Author

N91-21156# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Fluid Dynamics Panel.
ROTARY-BALANCE TESTING FOR AIRCRAFT DYNAMICS
1991 267 p
(AGARD-AR-265; ISBN-92-835-0597-2) Copyright Avail: NTIS HC/MF A12; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

The results of a study on rotary-balance testing for aircraft dynamics are presented. Both the experimental techniques used to obtain rotary-flow aerodynamics data and the procedures involved in using this type of data in the mathematical modeling of the dynamic behavior of a maneuvering fighter aircraft are examined. A special effort was made to summarize experiences involving correlation of dynamic behavior predictions with the observed motions of free-flight models and aircraft in flight. Specific hardware and problems encountered in rotary-balance experiments were addressed for experimental facilities in several countries and advanced applications were noted. Author

N91-21157* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
HIGH-PRESSURE PROMOTED COMBUSTION CHAMBER
Patent
Michelle A. Rucker, inventor (to NASA) and Joel M. Stoltzfus, inventor (to NASA) 5 Feb. 1991 11 p Filed 18 Jul. 1989
Supersedes N90-16771 (28 - 9, p 1170)
(NASA-Case-MSC-21470-1; US-Patent-4,990,312; US-Patent-Appl-SN-381239; US-Patent-Class-422-78; US-Patent-Class-422-80; US-Patent-Class-422-104; US-Patent-Class-374-8; US-Patent-Class-73-865.6; Int-Patent-Class-G01N-31/12) Avail: US Patent and Trademark Office CSCL 14B

In the preferred embodiment of the promoted combusiton chamber disclosed herein, a thick-walled tubular body that is capable of withstanding extreme pressures is arranged with removable upper and lower end closures to provide access to the chamber for dependently supporting a test sample of a material being evaluated in the chamber. To facilitate the real-time analysis of a test sample, several pressure-tight viewing ports capable of withstanding the simulated environmental conditions are arranged in the walls of the tubular body for observing the test sample during the course of the test. A replaceable heat-resistant tubular member and replaceable flame-resistant internal liners are arranged to be fitted inside of the chamber for protecting the interior wall surfaces of the combustion chamber during the evaluation tests. Inlet and outlet ports are provided for admitting high-pressure gases into the chamber as needed for performing dynamic analyses of the test sample during the course of an evaluation test.
Official Gazette of the U.S. Patent and Trademark Office

N91-21158# Federal Aviation Administration, Washington, DC. Office of Airport Safety and Standards.
A GUIDE TO GROUND VEHICLE OPERATIONS ON THE AIRPORT
Aug. 1990 29 p
(AD-A231077; DOT/FAA/AS-90-3) Avail: NTIS HC/MF A03 CSCL 05/6

Some airport operators, airlines, and fixed base operators have extensive formal training programs for employees whose duties involve operating a ground vehicle on the air operations area. However, many rely solely on informal on-the-job training. In an effort to improve the safety of ground vehicle operations on airports, the FAA developed this guide to ground vehicle operations. The guide provides airport orientation and operational information and would be used as a resource document by the airport operators and other members of the aviation community responsible for training ground vehicle operators. In addition to orientation and operational information, the guide touches on some other areas that a ground vehicle operator may encounter such as foreign object damage, security, and reporting emergencies. GRA

N91-21199*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
A SOLID-STATE CONTROLLABLE POWER SUPPLY FOR A MAGNETIC SUSPENSION WIND TUNNEL
Taumi S. Daniels and John S. Tripp *In its* Aerospace Applications of Magnetic Suspension Technology, Part 1 Mar. 1991 p 281-302 (For primary document see N91-21188 13-18)
Avail: NTIS HC/MF A17 CSCL 14B

12 ASTRONAUTICS (GENERAL)

For extraterrestrial exploration see *91 Lunar and Planetary Exploration.*

N91-21159# Norwegian Space Center, Oslo.
FROM EARTH TO SPACE AND BACK: SELECTED PAPERS ON NORWEGIAN SPACE ACTIVITIES
Ann-Lisbeth Ruud Holmet, ed. and Per Torbo, ed. Mar. 1990 51 p Submitted for publication
(NSC-Rept(90)2; ISBN-82-7542-003-2; ETN-91-98905) Avail: NTIS HC/MF A04

Selected papers on Norwegian space activities are presented to illustrate Norway's involvement in the area. Involvement of Norwegian industry and academic institutions in space research and development are summarized. Space based manufacturing of zeolite crystals is discussed. Communication satellite multicarrier demodulation optimization is studied. Application of offshore related technology to space activities is discussed and illustrated. A processing facility for synthetic aperture radar data is decribed. For individual titles, see N91-21160 through N91-21167.

N91-21160# Norwegian Space Center, Oslo.
DEVELOPMENT OF NORWEGIAN SPACE ACTIVITIES
Paal Soerensen *In its* From Earth to Space and Back: Selected Papers on Norwegian Space Activities Mar. 1990 p 3-5 (For primary document see N91-21159 13-12)
Avail: NTIS HC/MF A04

The history of Norwegian involvement in space activities is summarized. A full member of ESA since 1987, Norwegian space activities have extended in scope and depth. The development strategy of the Norwegian Space Agency is outlined. Considerable interest has beeen shown by Norwegian business in the Ariane 5, Columbus and Hermes programs. A remote sensing service called ERS-1 planned for development from 1989 to 1992 is outlined. The major research and development and manufacturing companies in Norway are members of the Norwegian Industrial Forum for Space Activities (NIFRO). The companies belonging to this group are listed. ESA

N91-21161# Norsk Data A.S., Oslo.
DESIGN OF A PROCESSING FACILITY FOR SYNTHETIC APERTURE RADAR DATA AT THE TROMSO ERS-1 GROUND STATION **c14**
Arve Maaoey, Sverre Holm, and Morten Toverud (Norwegian Defence Research Establishment, Kjeller.) *In* Norwegian Space Center, From Earth to Space and Back: Selected Papers on Norwegian Space Activities Mar. 1990 p 6-12 Previously announced in IAA as A90-26853 (For primary document see N91-21159 13-12)
Avail: NTIS HC/MF A04

A high performance processing facility for Synthetic Aperture Radar (SAR) from the ERS-1 satellite is described. The system processes 100 km by 100 km SAR image data products in eight

minutes. Several SAR products complying with ESA standards are provided. The system is a commercially available product based on a computer architecture developed at the Norwegian Defence Research Establishment. The main processing power is obtained from a 320 mflops programmable array processor. A standard ND-5000 minicomputer is used as front end processor. ESA

N91-21162# Norges Tekniske Hoegskole, Trondheim.
OFFSHORE TECHNOLOGY R AND D IN SPACE APPLICATIONS **c85**
Stewart D. W. Clark *In* Norwegian Space Center, From Earth to Space and Back: Selected Papers on Norwegian Space Activities Mar. 1990 p 13-18 (For primary document see N91-21159 13-12)
Avail: NTIS HC/MF A04

Space research and development can benefit from applying some of the R and D (Research and Development) already done for challenging offshore environments found in Norwegian waters. The considerable body of offshore and microelectronics expertise at the SINTEF group is utilized in the European Space Agency's Columbus and Hermes programs. This large contract research orgnization, which spans the offshore and shipping markets, medical technology and miocroelectronics, is a technological resource for the whole of the European space industry. Various lines of research undertaken by members of the SINTEF grpup which could find potential space based applications are outlined. ESA

N91-21163# Micro Electronics A.S. Space, Horten (Norway).
APPLICATION OF SAW TECHNOLOGY IN SATELLITES FOR MOBILE SERVICES **c32**
O. Andreassen, V. Viddal, and J. Galteland *In* Norwegian Space Center, From Earth to Space and Back: Selected Papers on Norwegian Space Activities Mar. 1990 p 19-23 Previously announced in IAA as A90-26854 (For primary document see N91-21159 13-12)
Avail: NTIS HC/MF A04

The expansion of possibilities for communicating while travelling at sea, on land, and in the air is discussed. The role played by communication satellites in such new communication possibilities is outlined. The use of conventianal SAW (Surface Acoustic Wave) filters and the SAW FROBE concept used for IF (Intermediate Frequency) processing in a mobile satellite is discussed. Ways in which SAW allows for more efficient and flexible utilization of channel capacity in communication satellite transponders are outlined. The SAW FROBE is able to give high resolution at modest cost in volume and power for small bandwidths. ESA

N91-21164# ELAB-RUNIT, Trondheim (Norway).
SAW TECHNOLOGY FOR MULTICARRIER DEMODULATION IN ADVANCED PAYLOADS **c32**
Vidar Ringset, Erik Olsen, Arne Roennekleiv, Petter Bakken, and Gunnar Bjoernstroem (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* Norwegian Space Center, From Earth to Space and Back: Selected Papers on Norwegian Space Activities Mar. 1990 p 24-30 Previously announced in IAA as A91-22923 Sponsored by Royal Norwegian Council for Scientific and Industrial Research and Norwegian Space Center, Oslo (For primary document see N91-21159 13-12)
(Contract ESA-6899/86/NL(SC))
Avail: NTIS HC/MF A04

Onboard satellite processing, including demodulation and regeneration, can greatly enhance the flexibility of resource allocation and RF power and bandwidth efficiency of advanced payloads, particularly when multibeam antennas are employed. SAW (Surface Acoustic Wave) technology is the most powerful approach when demodulation of a large number of flow data rate uplink signals is required. An Electrical Demonstration Model (EDM) of a 300 channel MultiCarrier Demodulator (MCD) employing a SAW Chirpo Fourier Transformer (CFT) for frequency demultiplexing, followed by digital demodulation is successfully designed and manufactured. The incoming signal is first multiplied in a bilinear mixer by three parallel digitally generated chirp signals and then convolved in a SAW chirp line manufactured on quartz. The digital part of the demolulator works as any other high quality demodulator, but the algorithms are selected in order to reduce the computational burden. The system is designed for a land mobile satellite transmitting coded voice and data at 9.6 kb/s. The design and performance of the EDM are described. ESA

N91-21165# Center for Industrial Research, Oslo (Norway).
ZEOLITES IN SPACE **c29**
Arnfinn G. Andersen and Michael Stoecher *In* Norwegian Space Center, From Earth to Space and Back: Selected Papers on Norwegian Space Activities Mar. 1990 p 31-32 (For primary document see N91-21159 13-12)
Avail: NTIS HC/MF A04

The synthesis of zeolites for use in industrial processes is described. Zeolites are used as calalysts in cracking of heavy oil components amongst other applications. Although found as minerals in nature, synthetic or modified zeolites are used in most industrial applications. A program involving a zeolite growth experiment under microgravity on board the Eureca-1 platform is described. Microgravity simulation crystal growth experiments carried out at the Solution Growth Facility (SGF) are described. They involve growing zeolites in numerous concentrations of the reactants. Products of such synthesis, characterized by X-ray techniques and electron microscopy, are described. ESA

N91-21166# Norwegian Defence Research Establishment, Kjeller.
NORWEGIAN STUDIES OF PLASMA MODIFICATIONS AROUND SPACECRAFT AND HOW THESE AFFECT THE VEHICLE POTENTIAL **c46**
Bernt N. Maehlum *In* Norwegian Space Center, From Earth to Space and Back: Selected Papers on Norwegian Space Activities Mar. 1990 p 33-38 Previously announced in IAA as A90-26855 (For primary document see N91-21159 13-12)
Avail: NTIS HC/MF A04

The Norwegian Defence Research Establishment (NDRE) is actively invloved in studies of various types of disturbances created by spacecraft in the Earth's ionosphere and the associated vehicle charging. Studies based on cooperative experiments with scientists from all over the world, including active and passive instruments on spacecaft and in the laboratory are described. The possibility of electrostatic breakdown in onboard spacecraft electronics due to a high build up in potential gradients is discussed. Involvement of the NDRE in helping develop a system of plasma interaction monitors for the Space Station Freedom is discussed. ESA

N91-21167# Norwegian Space Center, Oslo.
SPACE RESEARCH IN NORWAY **c46**
B. N. Andersen *In its* From Earth to Space and Back: Selected Papers on Norwegian Space Activities Mar. 1990 p 39-48 Previously announced in IAA as A90-26856 (For primary document see N91-21159 13-12)
Avail: NTIS HC/MF A04

Norwegian activity in space science is summarized. Particular emphasis is given to activities during 1988 and 1986. An overview of work carried out in the area of space physics, astrophysics and life sciences is presented. Study of ionospheric/magnetospheric processes carried out at the University of Bergen is described. Substorm processes, auroral emissions, large and small scale auroral dynamics and wave particle interactions in the magnetosphere and polar ionosphere carried out at the University of Oslo are outlined. ESA

N91-21168*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
PARAMETRIC ENTRY CORRIDORS FOR LUNAR/MARS AEROCAPTURE MISSIONS
Lisa M. Ling, Franco M. Baseggio, and Douglas P. Fuhry (Draper, Charles Stark Lab., Inc., Cambridge, MA) Apr. 1991 73 p (NASA-TM-102178; S-628; NAS 1.15:102178) Avail: NTIS HC/MF A04 CSCL 22A

Parametric atmospheric entry corridor data are presented for Earth and Mars aerocapture. Parameter ranges were dictated by the range of mission designs currently envisioned as possibilities for the Human Exploration Initiative (HEI). This data, while not providing a means for exhaustive evaluation of aerocapture performance, should prove to be a useful aid for preliminary mission design and evaluation. Entry corridors are expressed as ranges of allowable vacuum periapse altitude of the planetary approach hyperbolic orbit, with chart provided for conversion to an approximate flight path angle corridor at entry interface (125 km altitude). The corridor boundaries are defined by open-loop aerocapture trajectories which satisfy boundary constraints while utilizing the full aerodynamic control capability of the vehicle (i.e., full lift-up or full lift-down). Parameters examined were limited to those of greatest importance from an aerocapture performance standpoint, including the approach orbit hyperbolic excess velocity, the vehicle lift to drag ratio, maximum aerodynamic load factor limit, and the apoapse of the target orbit. The impact of the atmospheric density bias uncertainties are also included. The corridor data is presented in graphical format, and examples of the utilization of these graphs for mission design and evaluation are included. Author

13 ASTRODYNAMICS

Includes powered and free-flight trajectories; and orbital and launching dynamics.

N91-21169# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
OD SYSTEM FOR THE FIRST BRAZILIAN SATELLITE-SOFTWARE TESTING, ANALYSIS, AND ASSESSMENT
Helio Koiti Kuga and Kondapalli Rama Rao Oct. 1990 17 p Presented at the 1st Brazilian Symposium of Aerospace Technology, Sao Jose dos Campos, Brazil, 27-31 Aug. 1990
(INPE-5158-PRE/1637) Avail: NTIS HC/MF A03

The objective was to test, analyze, and assess the orbit determination (OD) system software developed for the first Brazilian satellite and the Institute of Space Research (INPE). The OD method was based on the weighted least squares differential correction. The testing and analysis of the software was done using the tracking data of three satellites: (1) the GIOTTO (Halley comet encounter mission) of ESA; (2) the BRASILSAT (a Brazilian telecommunications satellite); and (3) the simulated orbits of the first Brazilian satellite. In order to have a better assessment of the software, various test cases with different combinations of perturbation models were chosen. The results obtained in all the test cases for the first two satellites were in very good agreement with those obtained by owner organizations, and the results obtained in the last case were satisfactory. Author

N91-21170# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil). Dept. of Mechanics.
REAL TIME ASSISTED TRACKING FOR LOW EARTH ORBIT SATELLITES
Helio Koiti Kuga and Valdemir Carrara Oct. 1990 14 p Presented at the 1st Brazilian Symposium of Aerospace Technology, Sao Jose dos Campos, Brazil, 27-31 Aug. 1990
(INPE-5157-PRE/1636) Avail: NTIS HC/MF A03

The problem of assisting the tracking antenna during a satellite pass over the tracking ground station is addressed. The assisted tracking provides the antenna pointing angles so as to allow acquisition of signal (AOS) and to avoid or minimize loss of communication with a reduced computation time. It estimates two orbit elements: the mean anomaly and the right ascension of the ascending node. The other Keplerian elements are considered constant. Whenever the communication with the satellite is established (locked), the assisted tracking process transforms the measured input tracking angles in an estimate of the mean anomaly and right ascension. The process was simulated in a digital computer for different tracking situations. It was supposed that in a given instant, the signal was lost. The error between the predicted values of the pointing angles and the real ones was then monitored. The error remained below one degree for any situation, assuring that the communication could be promptly re-established whenever the signal is recovered. Author

N91-21171# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil). Dept. of Mechanical Engineering.
A STOCHASTIC APPROACH TO THE PROBLEM OF SPACECRAFT OPTIMAL MANOEUVRES
Antonio Fernando Ber deAlmeidaPrado and Atair Rios Neto Nov. 1990 8 p Presented at the 11th World Congress of the International Federation of Automatic Control, Tallin, USSR, 13-17 Aug. 1990
(INPE-5192-PRE/1660) Avail: NTIS HC/MF A02

The problem of spacecraft orbit transfer with minimum fuel consumption is considered. A new version of the suboptimal and hybrid control approach of numerically treating the problem, where one can take into account the accuracy in the satisfaction of constraints, is developed. To solve the nonlinear programming problem in each iteration, a stochastic version of the projection of the gradient method is used together with the well known hybrid approach to find the optimal control in this kind of dynamic problem. For the maneuvers considered, the spacecraft is supposed to be in keplerian motion perturbed by the thrustors whenever they are active. These thrustors are assumed to be of fixed magnitude (either low or high) and operating in an on-off mode. The solution is given in terms of the location of the burning arcs, time histories of thrustors attitude (pitch or yaw), final orbit acquired, and fuel consumed. Numerical results are presented. Author

14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)

Includes launch complexes, research and production facilities; ground support equipment, e.g., mobile transporters; and simulators.

For related information see also *09 Research and Support Facilities (Air).*

N91-21172# Department of Energy, Albuquerque, NM.
KAUAI TEST FACILITY TWO EXPERIMENT ROCKET CAMPAIGN
1991 38 p
(DE91-008894; DOE/EA-0492) Avail: NTIS HC/MF A03

The Kauai Test Facility (KTF) is a Department of Energy (DOE) owned facility located at Barking Sands, on the west coast of the island of Kauai, Hawaii. The KTF has a rocket preparation and launching capability for both rail-launched and vertical-launched rockets. Launches primarily support high altitude scientific research and re-entry vehicle systems and carry experimental non-nuclear payloads. This environmental assessment (EA) has been prepared for the Two Experiment Rocket Campaign, during which the STRYPI/LACE (STRYPI is not an acronym -- its the name of the rocket; LACE is the acronym for Low Altitude Compensation Experiment) and the rocket accelerated penetration (RAP)-501 will be flown in conjunction from the KTF in February 1991 to reduce costs. There have been numerous rocket campaigns at the KTF in prior years that have used the same motors to be used in the current two experiment rocket campaign. The main difference noted in this environmental documentation is that the two rockets have not previously been flown in conjunction. Previous National Environmental Policy Act (NEPA) approvals of launches using these motors were limited to different and separate campaigns with diverse sources of funding. DOE

N91-21173# Institut Franco-Allemand de Recherches, Saint-Louis (France).
CONSIDERATIONS AND STUDIES FOR THE CONSTRUCTION OF ACCELERATION COILS FOR INDUCTIVE LAUNCHERS [UEBERLEGUNGEN UND UNTERSUCHIUNGEN ZUM BAU VON ANTRRIEBSSPULEN FUER INDUKTIVE SPULENBESCHLEUNIGER]
H. Nett and L. Gernandt 9 Nov. 1989 26 p In GERMAN Presented at CCRE Commission Meeting on Elektromagnetische Beschleunigung, Saint-Louis, France, 14 Mar. 1989 Original contains color illustrations
(Contract BMVg-T/R-760/K-0012/K-1712)
(ISL-CO-240/89; ETN-91-98985) Avail: NTIS HC/MF A03

An experimental launcher which uses coils to create a magnetic field for the acceleration effect is studied. An experimental device for the selection of appropriate coils, the testing of necessary measurements and the first launchings with simple projectiles are described. The functioning of transformer coils with flux concentration is explained and the first results and experiments are presented. The possibilities of increasing the efficiency of the coils are studied. It is concluded that an improved coil with smaller resistance and lower inductive losses would be an interesting solution. ESA

N91-21174# Institut Franco-Allemand de Recherches, Saint-Louis (France).
ADVANTAGE OF NONGUIDED HYPERVELOCITY PROJECTILES IN ANTIMISSILE WARFARE [INTERET DES PROJECTILES HYPERVELOCES NON GUIDES DANS LA LUTTE ANTI-MISSILE]
G. Raynaud and G. PieuchotdeRavisy 8 Jun. 1990 84 p In FRENCH Original contains color illustrations
(ISL-R-110/90; ETN-91-98995) Avail: NTIS HC/MF A05

In the context of research on the advantage of hypervelocity projectiles, the mm 38 Exocet missile is studied. Account is taken of ablation since firing took place in the atmosphere, and the projectiles used are presumed to be tungsten alloy resisting up to 3500 m/s. Direct firing and proximity fused shell firing are studied as two possible solutions. In the first case all precision firing was supposed to destroy the missile: the difficulties of firing by bursts with electric guns lead to the consideration of ammunition containing subprojectiles, liberated after a cetain flight time. A vulnerability model of the Exocet was constructed and destruction probability was iproved by using a proximity fuse releasing at constant angle. These simulations lead to the following conclusions: the use of fused shell firing is disadvantageous; the development of direct firing of hypervelocity shells containing subammunition would perhaps be advantageous. However, destruction obtained by direct firing is not as good as that obtained with proximity fused shells. The advantage of nonguided hypervelocity projectiles in antimissile warfare does not appear to be demonstrated. ESA

N91-21175* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
O-RING GASKET TEST FIXTURE Patent
James Eric Turner, inventor (to NASA) and Donald Scott McCluney, inventor (to NASA) 19 Mar. 1991 9 p Filed 5 Jun. 1989 Supersedes N89-28546 (27 - 23, p 3253)
(NASA-Case-MFS-28376-1; US-Patent-5,000,033; US-Patent-Appl-SN-361479; US-Patent-Class-73-49.8; Int-Patent-Class-G01M-3/28) Avail: US Patent and Trademark Office CSCL 14B

An apparatus is presented for testing O-ring gaskets under a variety of temperature, pressure, and dynamic loading conditions. Specifically, this apparatus has the ability to simulate a dynamic loading condition where the sealing surface in contact with the O-ring moves both away from and axially along the face of the O-ring. NASA

N91-21176* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
TORSIONAL SUSPENSION SYSTEM FOR TESTING SPACE STRUCTURES Patent
Wilmer H. Reed, III, inventor (to NASA) and Ronald R. Gold, inventor (to NASA) 26 Feb. 1991 6 p Filed 26 May 1989 Supersedes N89-28547 (27 - 23, p 3253)
(NASA-Case-LAR-14149-1-SB; US-Patent-4,995,272; US-Patent-Appl-SN-357757; US-Patent-Class-73-865.6; US-Patent-Class-73-866.4; US-Patent-Class-73-663; Int-Patent-Class-G01M-7/02; Int-Patent-Class-G01M-19/00)
Avail: US Patent and Trademark Office CSCL 14B

A low frequency torsional suspension system for testing a space structure uses a plurality of suspension stations attached to the space structure along the length thereof in order to suspend the space structure from an overhead support. Each suspension station includes a disk pivotally mounted to the overhead support, and two cables which have upper ends connected to the disk and lower ends connected to the space structure. The two cables define a parallelogram with the center of gravity of the space structure being vertically beneath the pivot axis of the disk. The vertical distance between the points of attachment of the cables to the disk and the pivot axis of the disk is adjusted to lower the frequency of the suspension system to a level which does not interfere with frequency levels of the space structure, thereby enabling accurate measurement.
Official Gazette of the U.S. Patent and Trademark Office

N91-21161# Norsk Data A.S., Oslo.
DESIGN OF A PROCESSING FACILITY FOR SYNTHETIC APERTURE RADAR DATA AT THE TROMSO ERS-1 GROUND STATION
Arve Maaoey, Sverre Holm, and Morten Toverud (Norwegian Defence Research Establishment, Kjeller.) *In* Norwegian Space Center, From Earth to Space and Back: Selected Papers on Norwegian Space Activities Mar. 1990 p 6-12 Previously announced in IAA as A90-26853 (For primary document see N91-21159 13-12)
Avail: NTIS HC/MF A04

15 LAUNCH VEHICLES AND SPACE VEHICLES

Includes boosters; operating problems of launch/space vehicle systems; and reusable vehicles.

For related information see also *20 Spacecraft Propulsion and Power.*

N91-21177*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
DYNAMIC RESPONSE OF A HAMMERHEAD LAUNCH VEHICLE WIND-TUNNEL MODEL
Stanley R. Cole and Thomas L. Henning (General Dynamics Corp., San Diego, CA.) Feb. 1991 12 p Presented at the 32nd Structures, Structural Dynamics and Materials Conference, Baltimore, MD, 8-10 Apr. 1991
(NASA-TM-104050; NAS 1.15:104050) Avail: NTIS HC/MF A03 CSCL 22B

A wind-tunnel test of a 1/10th-scale Atlas-Centaur I large payload fairing launch vehicle model was conducted in the NASA Langley Transonic Dynamics Tunnel. The wind tunnel model was an aeroelastically-scaled version of the flight vehicle and was capable of simulating either of the first two bending vibration modes of the full-scale vehicle by a partial mode technique. The primary purpose of the test was to gather data concerning buffet response which could be used to clear the vehicle for flight. Additionally, angle-of-attack studies were conducted and several payload fairing configurations were tested to assess the buffet response and dynamic stability of off-design flight conditions and geometric parameters. No dynamic instabilities were found for any of the configurations tested. The buffet response data for the nominal flight configuration indicate that the unsteady buffet loads represent 5 to 10 percent of the total design load; therefore, the buffet loads are not a large factor affecting the overall vehicle design. Payload fairing length-to-diameter ratio variations were found to have small effects on the buffet response of the model, except in

the case of the smallest length-to-diameter models for the second bending mode simulation. The effects of angle of attack on buffet response were found to be small. The model was more sensitive to Mach number changes than to angle of attack. The buffet response results from this wind tunnel test were influenced by the tunnel facility vibration levels. An attempt was made to experimentally reduce the effect of the facility mechanical vibration for the nominal flight configuration by testing with vertical rods used to stiffen the sting support. The first flight of the Atlas-Centaur I vehicle successfully occurred on July 25, 1990, and a comparison of flight measurements with wind tunnel data is presented. The flight data was found to be well within the 3 sigma level of the wind tunnel data. Author

N91-21178# Aerospace Corp., El Segundo, CA.
QUALITY FUNCTION DEPLOYMENT IN LAUNCH OPERATIONS
P. L. Portanova and E. J. Tomei, Jr. 23 Nov. 1990 84 p
(Contract F04701-88-C-0089)
(AD-A230983; TOR-0091(6561-04)-1) Avail: NTIS HC/MF A05 CSCL 05/1

The goal of the Advanced Launch System (ALS) is a more efficient launch capability that provides a highly reliable and operable system at substantially lower cost than current launch systems. Total Quality Management (TQM) principles are being emphasized throughout the ALS program. A continuous improvement philosophy is directed toward satisfying users' and customer's requirements in terms of quality, performance, schedule, and cost. Quality Function Deployment (QFD) is interpreted as the voice of the customer (or user), and it is an important planning tool in translating these requirements throughout the whole process of design, development, manufacture, and operations. This report explores the application of QFD methodology to launch operations, including the modification and addition of events (operations planning) in the engineering development cycle, and presents an informal status of study results to date. QFD is a technique for systematically analyzing the customer's (Space Command) perceptions of what constitutes a highly reliable and operable system and functionally breaking down those attributes to identify the critical characteristics that determine an efficient launch system capability. In applying the principle of QFD, a series of matrices or charts are developed with emphasis on the one commonly known as the House of Quality (because of its roof-like format), which identifies and translates the most critical information. GRA

16 SPACE TRANSPORTATION

Includes passenger and cargo space transportation, e.g., shuttle operations; and space rescue techniques.

For related information see also *03 Air Transportation and Safety* and *18 Spacecraft Design, Testing and Performance*. For space suits see *54 Man/System Technology and Life Support*.

N91-21179*# Vought Corp., Dallas, TX.
SHUTTLE ENTRY AIR DATA SYSTEM (SEADS) HARDWARE DEVELOPMENT. VOLUME 1: SUMMARY Report, Nov. 1975 - Jan. 1982
D. M. While Jan. 1983 107 p
(Contract NAS1-16000)
(NASA-CR-166044-Vol-1; NAS 1.26:166044-Vol-1) Avail: NTIS HC/MF A06 CSCL 22B

Hardware development of the Shuttle Entry Data System (SEADS) is described. The system consists of an array of fourteen pressure ports, installed in an Orbiter nose cap, which, when coupled with existing fuselage mounted static pressure ports permits computation of entry flight parameters. Elements of the system that are described include the following: (1) penetration assemblies to place pressure port openings at the surface of the nose cap; (2) pressure tubes to transmit the surface pressure to transducers; (3) support posts or manifolds to provide support for, and reduce the length of, the individual pressure tubes; (4) insulation for the manifolds; and (5) a SEADS nose cap. Design, analyses, and tests to develop and certify design for flight are described. Specific tests include plasma arc exposure, radiant thermal, vibration, and structural. Volume one summarizes highlights of the program, particularly as they relate to the final design of SEADS. Volume two summarizes all of the Vought responsible activities in essentially a chronological order. Author

N91-21180*# Vought Corp., Dallas, TX.
SHUTTLE ENTRY AIR DATA SYSTEM (SEADS) HARDWARE DEVELOPMENT. VOLUME 2: HISTORY Report, Nov. 1975 - Jan. 1982
D. M. While Jan. 1983 325 p
(Contract NAS1-16000)
(NASA-CR-166044-Vol-2; NAS 1.26:166044-Vol-2) Avail: NTIS HC/MF A14 CSCL 22B

Hardware development of the Shuttle Entry Air Data System (SEADS) is described. The system consists of an array of fourteen pressure ports, installed in an Orbiter nose cap, which, when coupled with existing fuselage mounted static pressure ports permits computation of entry flight parameters. Elements of the system that are described include the following: (1) penetration assemblies to place pressure port openings at the surface of the nose cap; (2) pressure tubes to transmit the surface pressure to transducers; (3) support posts or manifolds to provide support for, and reduce the length of, the individual pressure tubes; (4) insulation for the manifolds; and (5) a SEADS nose cap. Design, analyses, and tests to develop and certify design for flight are described. Specific tests included plasma arc exposure, radiant thermal, vibration, and structural. Volume one summarizes highlights of the program, particularly as they relate to the final design of SEADS. Volume two summarizes all of the Vought responsible activities in essentially a chronological order. Author

N91-21181# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Lampoldshausen (Germany, F.R.). Inst. fuer Chemische Antriebe und Verfahrenstechnik.
EVALUATION OF TRANSPORTATION SYSTEMS FOR ADVANCED SPACEFLIGHT MISSIONS Ph.D. Thesis - Stuttgart Univ.
Juergen P. Schleinitz Jul. 1990 187 p In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-1256)
(DLR-FB-90-39; ISSN-0171-1342; ETN-91-99033) Avail: NTIS HC/MF A09; DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 65.65 DM

In order to perform a system analysis employing three completely different mission possibilities, propulsion system mass and cost models are determined. Electrostatic, nuclear thermal, solarthermal or laser thermal propulsion, as well as solar sails and aerobraking were considered. Advantages such as the drop of transport costs in near-Earth and cis-lunar orbits are expected with the implementation of solar thermal propulsion. Electric propulsion systems will have advantages in the transfer of large payloads, particularly in interplanetary operations. Laser thermal propulsion must be used only when the existing laser stations are used for additional applications. ESA

N91-21182*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
FIRE SUPPRESSION IN HUMAN-CREW SPACECRAFT
Robert Friedman and Daniel L. Dietrich (Sverdrup Technology, Inc., Brook Park, OH.) May 1991 14 p Presented at the Halon Alternatives Technical Working Conference, Albuquerque, NM, 30 Apr. - 1 May 1991; sponsored in part by New Mexico Univ.; and by The Center for Global Environmental Technologies
(Contract NAS3-25266)
(NASA-TM-104334; E-6100; NAS 1.15:104334) Avail: NTIS HC/MF A03 CSCL 06K

Fire extinguishment agents range from water and foam in early-design spacecraft (Halon 1301 in the present Shuttle) to carbon dioxide proposed for the Space Station Freedom. The major

challenge to spacecraft fire extinguishment design and operations is from the micro-gravity environment, which minimizes natural convection and profoundly influences combustion and extinguishing agent effectiveness, dispersal, and post-fire cleanup. Discussed here are extinguishment in microgravity, fire-suppression problems anticipated in future spacecraft, and research needs and opportunities. Author

N91-21183*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
AEROBRAKE ASSEMBLY WITH MINIMUM SPACE STATION ACCOMMODATION
Steven J. Katzberg, David H. Butler, William R. Doggett, James W. Russell, and Theresa Hurban (North Carolina State Univ., Raleigh.) Apr. 1991 129 p
(NASA-TM-102778; NAS 1.15:102778) Avail: NTIS HC/MF A07 CSCL 22A

The minimum Space Station Freedom accommodations required for initial assembly, repair, and refurbishment of the Lunar aerobrake were investigated. Baseline Space Station Freedom support services were assumed, as well as reasonable earth-to-orbit possibilities. A set of three aerobrake configurations representative of the major themes in aerobraking were developed. Structural assembly concepts, along with on-orbit assembly and refurbishment scenarios were created. The scenarios were exercised to identify required Space Station Freedom accommodations. Finally, important areas for follow-on study were also identified. Author

17 SPACE COMM., SPACECRAFT COMM., COMMAND & TRACKING

Includes telemetry; space communications networks; astronavigation and guidance; and radio blackout.

For related information see also *04 Aircraft Communications and Navigation* and *32 Communications and Radar.*

N91-21184*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
GaAs MONOLITHIC RF MODULES FOR SARSAT DISTRESS BEACONS
Michael A. Cauley Apr. 1991 8 p Presented at the International Symposium on Optical Engineering and Photonics in Aerospace Sensing, Orlando, FL, 1-5 Apr. 1991; sponsored in part by the Society of Photo-Optical Instrumentation Engineers
(NASA-TM-104338; E-6107; NAS 1.15:104338) Avail: NTIS HC/MF A02 CSCL 17B

Monolithic GaAs UHF components for use in SARSAT Emergency Distress beacons are under development by Microwave Monolithics, Inc., Simi Valley, CA. The components include a bi-phase modulator, driver amplifier, and a 5 watt power amplifier. Author

18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE

Includes satellites; space platforms; space stations; spacecraft systems and components such as thermal and environmental controls; and attitude controls.

For life support systems see *54 Man/System Technology and Life Support.* For related information see also *05 Aircraft Design, Testing and Performance, 39 Structural Mechanics,* and *16 Space Transportation.*

N91-21185*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
A NEW FABRICATION METHOD FOR PRECISION ANTENNA REFLECTORS FOR SPACE FLIGHT AND GROUND TEST
G. Richard Sharp, Joyce S. Wanhainen, and Dean A. Ketelsen Washington Mar. 1991 19 p Presented at the 13th International Communications Satellite Systems Conference, Los Angeles, CA, 11-15 Mar. 1990; sponsored by AIAA Previously announced in IAA as A90-25627 Original contains color illustrations
(NASA-TP-3078; E-5176; NAS 1.60:3078) Avail: NTIS HC/MF A03; 2 functional color pages CSCL 22B

Communications satellites are using increasingly higher frequencies that require increasingly precise antenna reflectors for use in space. Traditional industry fabrication methods for space antenna reflectors employ successive modeling techniques using high- and low-temperature molds for reflector face sheets and then a final fit-up of the completed honeycomb sandwich panel antenna reflector to a master pattern. However, as new missions are planned at much higher frequencies, greater accuracies will be necessary than are achievable using these present methods. A new approach for the fabrication of ground-test solid-surface antenna reflectors is to build a rigid support structure with an easy-to-machine surface. This surface is subsequently machined to the desired reflector contour and coated with a radio-frequency-reflective surface. This method was used to fabricate a 2.7-m-diameter ground-test antenna reflector to an accuracy of better than 0.013 mm (0.0005 in.) rms. A similar reflector for use on spacecraft would be constructed in a similar manner but with space-qualified materials. The design, analysis, and fabrication of the 2.7-m-diameter precision antenna reflector for antenna ground tests and the extension of this technology to precision, space-based antenna reflectors are described. Author

N91-21186*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
THE SPACECRAFT CONTROL LABORATORY EXPERIMENT OPTICAL ATTITUDE MEASUREMENT SYSTEM
Sharon S. Welch, Raymond C. Montgomery, and Michael F. Barsky (Virginia Polytechnic Inst. and State Univ., Blacksburg.) Mar. 1991 21 p
(NASA-TM-102624; NAS 1.15:102624) Avail: NTIS HC/MF A03 CSCL 22B

A stereo camera tracking system was developed to provide a near real-time measure of the position and attitude of the Spacecraft COntrol Laboratory Experiment (SCOLE). The SCOLE is a mockup of the shuttle-like vehicle with an attached flexible mast and (simulated) antenna, and was designed to provide a laboratory environment for the verification and testing of control laws for large flexible spacecraft. Actuators and sensors located on the shuttle and antenna sense the states of the spacecraft and allow the position and attitude to be controlled. The stereo camera tracking system which was developed consists of two position sensitive detector cameras which sense the locations of small infrared LEDs attached to the surface of the shuttle. Information on shuttle position and attitude is provided in six degrees-of-freedom. The design of this optical system, calibration, and tracking algorithm are described. The performance of the system is evaluated for yaw only. Author

N91-21187# General Accounting Office, Washington, DC.
SPACE STATION: NASA'S SEARCH FOR DESIGN, COST, AND SCHEDULE STABILITY CONTINUES
Mar. 1991 41 p
(GAO/NSIAD-91-125) Avail: NTIS HC/MF A03

The General Accounting Office (GAO) reports on its investigations of the space station plans, focusing on changes in the design, estimated cost, and schedule. Also reviewed were budget requests and congressional funding, and the impact on the space station's cost and capabilities of the 1989 program review done by the National Aeronautics and Space Administration (NASA) to stabilize the space station's design and schedule at achievable funding levels. NASA is described as being in phase 3 of 5 in the space station program. These phases are: (1) concept; (2) definition and preliminary design (ending with award of contracts for the next two phases); (3) detailed design; (4) development, manufacture, and assembly of components; and (5) operation. The last two phases will overlap and continue throughout the station's expected 30-year life. GAO identifies the primary objectives for the space station as advances in materials and life sciences. It also discusses changes that NASA has made to the program to

reduce risk, weight, power, maintenance, and costs, and the tradeoffs that were required to achieve improvements. GAO suggests that NASA's cost estimates could be more helpful to Congress if required in a different format. J.P.S.

N91-21188*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
AEROSPACE APPLICATIONS OF MAGNETIC SUSPENSION TECHNOLOGY, PART 1
Nelson J. Groom, ed. and Colin P. Britcher, ed. (Old Dominion Univ., Norfolk, VA.) Mar. 1991 377 p Workshop held in Hampton, VA, 25-27 Sep. 1990
(NASA-CP-10066-Pt-1; NAS 1.55:10066-Pt-1) Avail: NTIS HC/MF A17 CSCL 22B

Papers presented at the conference on aerospace applications of magnetic suspension technology are compiled. The following subject areas are covered: pointing and isolation systems; microgravity and vibration isolation; bearing applications; wind tunnel model suspension systems; large gap magnetic suspension systems; control systems; rotating machinery; science and application of superconductivity; and sensors. For individual titles, see N91-21189 through N91-21202.

N91-21189*# Honeywell, Inc., Glendale, AZ. Satellite Systems Operations.
MAGNETIC SUSPENSION SYSTEMS FOR SPACE APPLICATIONS
Douglas G. Havenhill and Patrick J. Wolke *In* NASA, Langley Research Center, Aerospace Applications of Magnetic Suspension Technology, Part 1 Mar. 1991 p 1-26 (For primary document see N91-21188 13-18)
Avail: NTIS HC/MF A17 CSCL 22B

An overview of techniques is presented used in the described magnetic suspension systems. Also a review is presented of the systems already developed, which demonstrate the usefulness, applicability, and flight readiness of magnetic suspension to a broad range of payloads and environments. The following subject areas are covered: programs overview; key concepts; magnetic suspension as an isolator and as a pointer; pointing and isolation systems; magnetic actuator control techniques; and test data. Y.S.

N91-21190*# AiResearch Mfg. Co., Los Angeles, CA.
ADVANCED MAGNETIC SUSPENSIONS FOR VIBRATION ISOLATION AND FAST-ATTITUDE CONTROL OF SPACE-BASED GENERIC POINTING MOUNTS
Robert W. Bosley and Anil N. Trivedi *In* NASA, Langley Research Center, Aerospace Applications of Magnetic Suspension Technology, Part 1 Mar. 1991 p 27-55 (For primary document see N91-21188 13-18)
Avail: NTIS HC/MF A17 CSCL 22B

Advanced magnetic suspension for vibration isolation and fast-attitude control of space-based generic pointing mounts (GPM) is presented in the form of viewgraphs. The following subject areas are covered: design criteria for GPM; GPM system features; GPM performance characteristics; GPM functional block diagram; and other applications for generic magnetic suspension technologies. Y.S.

N91-21191*# SatCon Technology Corp., Cambridge, MA.
A SUPERCONDUCTING LARGE-ANGLE MAGNETIC SUSPENSION
James Downer, James Goldie, and Richard Torti *In* NASA, Langley Research Center, Aerospace Applications of Magnetic Suspension Technology, Part 1 Mar. 1991 p 57-75 (For primary document see N91-21188 13-18)
Avail: NTIS HC/MF A17 CSCL 22B

The component technologies were developed required for an advanced control moment gyro (CMG) type of slewing actuator for large payloads. The key component of the CMG is a large-angle magnetic suspension (LAMS). The LAMS combines the functions of the gimbal structure, torque motors, and rotor bearings of a CMG. The LAMS uses a single superconducting source coil and an array of cryoresistive control coils to produce a specific output torque more than an order of magnitude greater than conventional devices. The designed and tested LAMS system is based around an available superconducting solenoid, an array of twelve room-temperature normal control coils, and a multi-input, multi-output control system. The control laws were demonstrated for stabilizing and controlling the LAMS system. Y.S.

N91-21192*# Virginia Univ., Charlottesville. Dept. of Mechanical and Aerospace Engineering.
CONTROL ISSUES OF MICROGRAVITY VIBRATION ISOLATION
Carl R. Knospe and Richard D. Hampton *In* NASA, Langley Research Center, Aerospace Applications of Magnetic Suspension Technology, Part 1 Mar. 1991 p 77-141 Sponsored by NASA, Lewis Research Center (For primary document see N91-21188 13-18)
Avail: NTIS HC/MF A17 CSCL 22B

Active vibration isolation systems contemplated for microgravity space experiments may be designed to reach given performance requirements in a variety of ways. An analogy to passive isolation systems proves to be illustrative but lacks the flexibility as a design tool of a control systems approach and may lead to poor design. Control theory as applied to vibration isolation is reviewed and passive analogies discussed. Author

N91-21193*# SatCon Technology Corp., Cambridge, MA.
SLIDING MODE CONTROL OF MAGNETIC SUSPENSIONS FOR PRECISION POINTING AND TRACKING APPLICATIONS
Kathleen M. Misovec, Frederick J. Flynn, Bruce G. Johnson, and J. Karl Hedrick (California Univ., Berkeley.) *In* NASA, Langley Research Center, Aerospace Applications of Magnetic Suspension Technology, Part 1 Mar. 1991 p 143-163 (For primary document see N91-21188 13-18)
(Contract DASG60-88-C-0040)
Avail: NTIS HC/MF A17 CSCL 22B

A recently developed nonlinear control method, sliding mode control, is examined as a means of advancing the achievable performance of space-based precision pointing and tracking systems that use nonlinear magnetic actuators. Analytic results indicate that sliding mode control improves performance compared to linear control approaches. In order to realize these performance improvements, precise knowledge of the plant is required. Additionally, the interaction of an estimating scheme and the sliding mode controller has not been fully examined in the literature. Estimation schemes were designed for use with this sliding mode controller that do not seriously degrade system performance. The authors designed and built a laboratory testbed to determine the feasibility of utilizing sliding mode control in these types of applications. Using this testbed, experimental verification of the authors' analyses is ongoing. Author

N91-21194*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
MAGNETIC BEARINGS WITH ZERO BIAS
Gerald V. Brown and Carlos M. Grodsinsky *In* NASA, Langley Research Center, Aerospace Applications of Magnetic Suspension Technology, Part 1 Mar. 1991 p 165-182 (For primary document see N91-21188 13-18)
Avail: NTIS HC/MF A17 CSCL 22B

A magnetic bearing operating without a bias field has supported a shaft rotating at speeds up to 12,000 rpm with the usual four power supplies and with only two. A magnetic bearing is commonly operated with a bias current equal to half of the maximum current allowable in its coils. This linearizes the relation between net force and control current and improves the force slewing rate and hence the band width. The steady bias current dissipates power, even when no force is required from the bearing. The power wasted is equal to two-thirds of the power at maximum force output. Examined here is the zero bias idea. The advantages and disadvantages are noted. Author

N91-21195*# SatCon Technology Corp., Cambridge, MA.
MAGNETIC BEARINGS FOR A SPACEFLIGHT OPTICAL DISK RECORDER
Richard Hockney, Vijay Gondhalekar, and Timothy Hawkey *In* NASA, Langley Research Center, Aerospace Applications of Magnetic Suspension Technology, Part 1 Mar. 1991 p 183-197 (For primary document see N91-21188 13-18)
(Contract NAS5-30309)
Avail: NTIS HC/MF A17 CSCL 22B

The development and testing of a magnetic bearing system for the translator of the read/write head in a magneto-optic disk drive are discussed. The asymmetrical three-pole actuators with permanent magnet bias support the optical head, and its tracking and focusing servos, through their radial excursion above the disk. The specifications for the magnetic bearing are presented, along with the configuration of the magnetic hardware. Development of a five degree of freedom collision model is examined which allowed assessment of the system response during large scale transients. Experimental findings and the results of performance testing are presented, including the roll-off of current-to-force due to eddy current loss in the magnetic materials. Author

N91-21196*# North Carolina Univ., Charlotte. Dept. of Electrical Engineering.
FIVE DEGREE-OF-FREEDOM CONTROL OF AN ULTRA-PRECISION MAGNETICALLY-SUSPENDED LINEAR BEARING Ph.D. Thesis - MIT
David L. Trumper and A. H. Slocum (Cranfield Inst. of Tech., Bedford, England) *In* NASA, Langley Research Center, Aerospace Applications of Magnetic Suspension Technology, Part 1 Mar. 1991 p 199-224 Sponsored in part by AF (For primary document see N91-21188 13-18)
Avail: NTIS HC/MF A17 CSCL 22B

The authors constructed a high precision linear bearing. A 10.7 kg platen measuring 125 mm by 125 mm by 350 mm is suspended and controlled in five degrees of freedom by seven electromagnets. The position of the platen is measured by five capacitive probes which have nanometer resolution. The suspension acts as a linear bearing, allowing linear travel of 50 mm in the sixth degree of freedom. In the laboratory, this bearing system has demonstrated position stability of 5 nm peak-to-peak. This is believed to be the highest position stability yet demonstrated in a magnetic suspension system. Performance at this level confirms that magnetic suspensions can address motion control requirements at the nanometer level. The experimental effort associated with this linear bearing system is described. Major topics are the development of models for the suspension, implementation of control algorithms, and measurement of the actual bearing performance. Suggestions for the future improvement of the bearing system are given.
Author

N91-21197*# Madison Magnetics, Inc., WI.
MAGNETIC SUSPENSION AND BALANCE SYSTEM ADVANCED STUDY, 1989 DESIGN
Roger W. Boom, Y. M. Eyssa, Moustafa K. Abdelsalam, and Glen E. McIntosh *In* NASA, Langley Research Center, Aerospace Applications of Magnetic Suspension Technology, Part 1 Mar. 1991 p 225-248 (For primary document see N91-21188 13-18)
Avail: NTIS HC/MF A17 CSCL 22B

The objectives are to experimentally confirm several advanced design concepts on the Magnetic Suspension and Balance Systems (MSBS). The advanced design concepts were identified as potential improvements by Madison Magnetics, Inc. (MMI) during 1984 and 1985 studies of an MSBS utilizing 14 external superconductive coils and a superconductive solenoid in an airplane test model suspended in a wind tunnel. This study confirmed several advanced design concepts on magnetic suspension and balance systems. The 1989 MSBS redesign is based on the results of these experiments. Savings of up to 30 percent in supporting magnet ampere meters and 50 percent in energy stored over the 1985 design were achieved. Author

N91-21198*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
PROPULSION SIMULATOR FOR MAGNETICALLY-SUSPENDED WIND TUNNEL MODELS
Prakash B. Joshi, C. L. Goldey, G. P. Sacco (Physical Sciences, Inc., Andover, MA.), and Pierce L. Lawing *In its* Aerospace Applications of Magnetic Suspension Technology, Part 1 Mar. 1991 p 249-280 (For primary document see N91-21188 13-18)
(Contract NAS1-18845)
Avail: NTIS HC/MF A17 CSCL 22B

The objective of phase two of a current investigation sponsored by NASA Langley Research Center is to demonstrate the measurement of aerodynamic forces/moments, including the effects of exhaust gases, in magnetic suspension and balance system (MSBS) wind tunnels. Two propulsion simulator models are being developed: a small-scale and a large-scale unit, both employing compressed, liquified carbon dioxide as propellant. The small-scale unit was designed, fabricated, and statically-tested at Physical Sciences Inc. (PSI). The large-scale simulator is currently in the preliminary design stage. The small-scale simulator design/development is presented, and the data from its static firing on a thrust stand are discussed. The analysis of this data provides important information for the design of the large-scale unit. A description of the preliminary design of the device is also presented. Author

N91-21199*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
A SOLID-STATE CONTROLLABLE POWER SUPPLY FOR A MAGNETIC SUSPENSION WIND TUNNEL **c09**
Taumi S. Daniels and John S. Tripp *In its* Aerospace Applications of Magnetic Suspension Technology, Part 1 Mar. 1991 p 281-302 (For primary document see N91-21188 13-18)
Avail: NTIS HC/MF A17 CSCL 14B

The NASA Langley 6-inch Magnetic Suspension and Balance System (6-in. MSBS) requires an independently controlled bidirectional dc power source for each of six positioning electromagnets. These electromagnets provide five-degree-of-freedom control over a suspended aerodynamic test model. Existing power equipment, which employs resistance-coupled thyratron-controlled rectifiers as well as ac to dc motor-generator converters, is obsolete, inefficient, and unreliable. A replacement six-phase bidirectional controlled bridge rectifier is proposed, which employs power MOSFET switches sequenced by hybrid analog/digital circuits. Full-load efficiency is 80 percent compared with 25 percent for the resistance-coupled thyratron system. Current feedback provides high control linearity, adjustable current limiting, and current overload protection. A quenching circuit suppresses inductive voltage impulses. It is shown that 20-kHz interference from positioning magnet power into MSBS electromagnetic model position sensors results predominantly from capacitively coupled electric fields. Hence, proper shielding and grounding techniques are necessary. Inductively coupled magnetic interference is negligible. Author

N91-21200*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
DESCRIPTION OF THE LARGE-GAP MAGNETIC SUSPENSION SYSTEM (LGMSS) GROUND BASED EXPERIMENT
Nelson J. Groom *In its* Aerospace Applications of Magnetic Suspension Technology, Part 1 Mar. 1991 p 303-324 (For primary document see N91-21188 13-18)
Avail: NTIS HC/MF A17 CSCL 22B

An overview of the Large Gap Magnetic Suspension System (LGMSS) ground-based experiment is provided. A description of the experiment, as originally defined, and the experiment objectives and potential applications of the technology resulting from the experiment are presented. Also, the results of two studies which were conducted to investigate the feasibility of implementing the experiment are presented and discussed. Finally, a description of the configuration which was selected for the experiment is described, and a summary of the paper is presented. Author

N91-21201*# Madison Magnetics, Inc., WI.
LARGE GAP MAGNETIC SUSPENSION SYSTEM
Moustafa K. Abdelsalam and Y. M. Eyssa *In* NASA, Langley Research Center, Aerospace Applications of Magnetic Suspension Technology, Part 1 Mar. 1991 p 325-354 (For primary document see N91-21188 13-18)
Avail: NTIS HC/MF A17 CSCL 22B

The design of a large gap magnetic suspension system is discussed. Some of the topics covered include: the system configuration, permanent magnet material, levitation magnet system, superconducting magnets, resistive magnets, superconducting levitation coils, resistive levitation coils, levitation magnet system, and the nitrogen cooled magnet system. K.S.

N91-21202*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
STABILITY CONSIDERATIONS FOR MAGNETIC SUSPENSION SYSTEMS USING ELECTROMAGNETS MOUNTED IN A PLANAR ARRAY
Nelson J. Groom and Colin P. Britcher (Old Dominion Univ., Norfolk, VA.) *In its* Aerospace Applications of Magnetic Suspension Technology, Part 1 Mar. 1991 p 355-376 (For primary document see N91-21188 13-18)
(Grant NAG1-1056)
Avail: NTIS HC/MF A17 CSCL 22B

Mathematical models of a 5, 6, 7, and 8 coil large gap magnetic suspension system (MSDS) are presented. Some of the topics covered include: force and torque equations, reduction of state-space form, natural modes, origins of modes, effect of rotation in azimuth (yaw), future work, and n-coil ring conclusions. K.S.

N91-21203*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
AEROSPACE APPLICATIONS OF MAGNETIC SUSPENSION TECHNOLOGY, PART 2
Nelson J. Groom, ed. and Colin P. Britcher, ed. (Old Dominion Univ., Norfolk, VA.) Mar. 1991 394 p Workshop held in Hampton, VA, 25-27 Sep. 1990
(NASA-CP-10066-Pt-2; NAS 1.55:10066-Pt-2) Avail: NTIS HC/MF A17 CSCL 22B

In order to examine the state of technology of all areas of magnetic suspension with potential aerospace applications, and to review related recent developments in sensors and control approaches, superconducting technology, and design/implementation practices, a workshop was held at NASA-Langley. Areas of concern are pointing and isolation systems, microgravity and virbration isolation, bearing applications, wind tunnel model suspension systems, large gap magnetic suspension systems, controls, rotating machinery, science and applications of superconductivity, and sensors. Papers presented are included. For individual titles, see N91-21204 through N91-21212.

N91-21204*# North Carolina Univ., Charlotte. Dept. of Electrical Engineering.
NONLINEAR COMPENSATION TECHNIQUES FOR MAGNETIC SUSPENSION SYSTEMS Ph.D. Thesis - MIT
David L. Trumper *In* NASA, Langley Research Center, Aerospace Applications of Magnetic Suspension Technology, Part 2 Mar. 1991 p 377-388 Sponsored in part by AF (For primary document see N91-21203 13-18)
Avail: NTIS HC/MF A17 CSCL 22B

In aerospace applications, magnetic suspension systems may be required to operate over large variations in air-gap. Thus the nonlinearities inherent in most types of suspensions have a significant effect. Specifically, large variations in operating point may make it difficult to design a linear controller which gives satisfactory stability and performance over a large range of operating points. One way to address this problem is through the use of nonlinear compensation techniques such as feedback linearization. Nonlinear compensators have received limited attention in the magnetic suspension literature. In recent years, progress has been made in the theory of nonlinear control systems, and in the sub-area of feedback linearization. The idea is demonstrated of feedback linearization using a second order suspension system. In the context of the second order suspension, sampling rate issues in the implementation of feedback linearization are examined through simulation. E.R.

N91-21205*# Massachusetts Inst. of Tech., Cambridge. Dept. of Electrical Engineering.
A TIME DELAY CONTROLLER FOR MAGNETIC BEARINGS
K. Youcef-Toumi and S. Reddy *In* NASA, Langley Research Center, Aerospace Applications of Magnetic Suspension Technology, Part 2 Mar. 1991 p 389-411 Sponsored in part by Ebara Research Corp., Ltd., Japan (For primary document see N91-21203 13-18)
Avail: NTIS HC/MF A17 CSCL 22B

The control of systems with unknown dynamics and unpredictable disturbances has raised some challenging problems. This is particularly important when high system performance needs to be guaranteed at all times. Recently, the Time Delay Control has been suggested as an alternative control scheme. The proposed control system does not require an explicit plant model nor does it depend on the estimation of specific plant parameters. Rather, it combines adaptation with past observations to directly estimate the effect of the plant dynamics. A control law is formulated for a class of dynamic systems and a sufficient condition is presented for control systems stability. The derivation is based on the bounded input-bounded output stability approach using L sub infinity function norms. The control scheme is implemented on a five degrees of freedom high speed and high precision magnetic bearing. The control performance is evaluated using step responses, frequency responses, and disturbance rejection properties. The experimental data show an excellent control performance despite the system complexity. Author

N91-21206*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
MICROGRAVITY VIBRATION ISOLATION: AN OPTIMAL CONTROL LAW FOR THE ONE-DIMENSIONAL CASE
Richard D. Hampton, Carlos M. Grodsinsky, Paul E. Allaire, David W. Lewis, and Carl R. Knospe (Virginia Univ., Charlottesville.) *In* NASA, Langley Research Center, Aerospace Applications of Magnetic Suspension Technology, Part 2 Mar. 1991 p 413-476 (For primary document see N91-21203 13-18)
Avail: NTIS HC/MF A17 CSCL 22B

Certain experiments contemplated for space platforms must be isolated from the accelerations of the platform. An optimal active control is developed for microgravity vibration isolation, using constant state feedback gains (identical to those obtained from the Linear Quadratic Regulator (LQR) approach) along with constant feedforward gains. The quadratic cost function for this control algorithm effectively weights external accelerations of the platform disturbances by a factor proportional to (1/omega) exp 4. Low frequency accelerations are attenuated by greater than two orders of magnitude. The control relies on the absolute position and velocity feedback of the experiment and the absolute position and velocity feedforward of the platform, and generally derives the stability robustness characteristics guaranteed by the LQR approach to optimality. The method as derived is extendable to the case in which only the relative positions and velocities and the absolute accelerations of the experiment and space platform are available. Author

N91-21207*# Duke Univ., Durham, NC. Dept. of Mechanical Engineering and Materials Science.
MEASUREMENT AND CALCULATION OF FORCES IN A MAGNETIC JOURNAL BEARING ACTUATOR
Josiah Knight, Edward McCaul, and Zule Xia *In* NASA, Langley Research Center, Aerospace Applications of Magnetic Suspension Technology, Part 2 Mar. 1991 p 477-498 (For primary document see N91-21203 13-18)
(Grant NAG3-968)
Avail: NTIS HC/MF A17 CSCL 22B

Numerical calculations and experimental measurements of

forces from an actuator of the type used in active magnetic journal bearings are presented. The calculations are based on solution of the scalar magnetic potential field in and near the gap regions. The predicted forces from single magnet with steady current are compared with experimental measurements in the same geometry. The measured forces are smaller than calculated ones in the principal direction but are larger than calculated in the normal direction. This combination of results indicate that material and spatial effects other than saturation play roles in determining the force available from an actuator. Author

N91-21208*# Draper (Charles Stark) Lab., Inc., Cambridge, MA.
DYNAMIC MODELLING AND ANALYSIS OF A MAGNETICALLY SUSPENDED FLEXIBLE ROTOR M.S. Thesis, 1988
Duncan C. McCallum *In* NASA, Langley Research Center, Aerospace Applications of Magnetic Suspension Technology, Part 2 Mar. 1991 p 499-537 (For primary document see N91-21203 13-18)
Avail: NTIS HC/MF A17 CSCL 22B

A 12-state lumped-element model is presented for a flexible rotor supported by two attractive force electromagnetic journal bearings. The rotor is modeled as a rigid disk with radial mass unbalance mounted on a flexible, massless shaft with internal damping (Jeffcott rotor). The disk is offset axially from the midspan of the shaft. Bearing dynamics in each radial direction are modeled as a parallel combination of a negative (unstable) spring and a linear current-to-force actuator. The model includes translation and rotation of the rigid mass and the first and second bending models of the flexible shaft, and it simultaneously includes internal shaft damping, gyroscopic effects, and the unstable nature of the attractive force magnetic bearings. The model is used to analyze the dependence of the system transmission zeros and open-loop poles on system parameters. The dominant open-loop poles occur in stable/unstable pairs with bandwidth dependent on the ratios of bearing (unstable) stiffnesses to rotor mass and damping dependent on the shaft spin rate. The zeros occur in complex conjugate pairs with bandwidth dependent on the ratios of shaft stiffness to rotor mass and damping dependent on the shaft spin rate. Some of the transmission zeros are non-minimum phase when the spin rate exceeds the shaft critical speed. The transmission zeros and open-loop poles impact the design of magnetic bearing control systems. The minimum loop cross-over frequency of the closed-loop system is the speed of the unstable open-loop poles. For the supercritical shaft spin rates, the presence of non-minimum phase zeros limits the distribution rejection achievable at frequencies near or above the shaft critical speed. Since non-minimum phase transmission zeros can only be changed by changing the system inputs and/or outputs, closed-loop performance is limited for supercritical spin rates unless additional force or torque actuators are added. Author

N91-21209*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Mechanical Engineering.
CRITICAL SPEEDS AND FORCED RESPONSE SOLUTIONS FOR ACTIVE MAGNETIC BEARING TURBOMACHINERY, PART 1
J. Keesee, D. Rawal, and R. Gordon Kirk *In* NASA, Langley Research Center, Aerospace Applications of Magnetic Suspension Technology, Part 2 Mar. 1991 p 539-558 Sponsored in part by Virginia Center for Innovative Technology; Dresser-Rand Co.; and Magnetic Bearings, Inc. (For primary document see N91-21203 13-18)
Avail: NTIS HC/MF A17 CSCL 22B

The prediction of critical speeds and forced response of active magnetic bearing turbomachinery is of great interest due to the increased use of this new and promising technology. Calculating the system undamped critical speeds and forced response is important to all those who are involved in the design of the active magnetic bearing system. An extended Jeffcott model which was used as an approximate solution to a more accurate transfer matrix procedure is presented. Theory behind a two-degree-of freedom extended Jeffcoat model is presented. Results of the natural frequency calculation are shown followed by the results of the forced response calculation. The system response was predicted for two types of forcing. A constant magnitude excitation with a wide frequency variation was applied at the bearings as one forcing function. The normal unbalance force at the midspan was the second source of excitation. The results of this extended Jeffcott solution gives useful design guidance for the influence of the first and third modes of a symmetric rotor system. Author

N91-21210*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Mechanical Engineering.
CRITICAL SPEEDS AND FORCED RESPONSE SOLUTIONS FOR ACTIVE MAGNETIC BEARING TURBOMACHINERY, PART 2
D. Rawal, J. Keesee, and R. Gordon Kirk *In* NASA, Langley Research Center, Aerospace Applications of Magnetic Suspension Technology, Part 2 Mar. 1991 p 559-582 Sponsored in part by Virginia Center for Innovative Technology; Dresser-Rand Co.; and Magnetic Bearings, Inc. (For primary document see N91-21203 13-18)
Avail: NTIS HC/MF A17 CSCL 22B

The need for better performance of turbomachinery with active magnetic bearings has necessitated a study of such systems for accurate prediction of their vibrational characteristics. A modification of existing transfer matrix methods for rotor analysis is presented to predict the response of rotor systems with active magnetic bearings. The position of the magnetic bearing sensors is taken into account and the effect of changing sensor position on the vibrational characteristics of the rotor system is studied. The modified algorithm is validated using a simpler Jeffcott model described previously. The effect of changing from a rotating unbalance excitation to a constant excitation in a single plane is also studied. A typical eight stage centrifugal compressor rotor is analyzed using the modified transfer matrix code. The results for a two mass Jeffcott model were presented previously. The results obtained by running this model with the transfer matrix method were compared with the results of the Jeffcott analysis for the purposes of verification. Also included are plots of amplitude versus frequency for the eight stage centrifugal compressor rotor. These plots demonstrate the significant influence that sensor location has on the amplitude and critical frequencies of the rotor system. Author

N91-21211*# Mechanical Technology, Inc., Latham, NY.
REDUCTION IN BEARING SIZE DUE TO SUPERCONDUCTORS IN MAGNETIC BEARINGS
Dantam K. Rao, Paul Lewis, and James F. Dill *In* NASA, Langley Research Center, Aerospace Applications of Magnetic Suspension Technology, Part 2 Mar. 1991 p 583-605 (For primary document see N91-21203 13-18)
Avail: NTIS HC/MF A17 CSCL 22B

A design concept that reduces the size of magnetic bearings is assessed. The small size will enable magnetic bearings to fit into limited available bearing volume of cryogenic machinery. The design concept, called SUPERC, uses (high Tc) superconductors or high-purity aluminum conductors in windings instead of copper. The relatively high-current density of these conductors reduces the slot radial thickness for windings, which reduces the size of the bearings. MTI developed a sizing program called SUPERC that translates the high-current density of these conductors into smaller sized bearings. This program was used to size a superconducting bearing to carry a 500 lb. load. The sizes of magnetic bearings needed by various design concepts are as follows: SUPERC design concept = 3.75 in.; magnet-bias design concept = 5.25 in.; and all electromagnet design concept = 7.0 in. These results indicate that the SUPERC design concept can significantly reduce the size of the bearing. This reduction, in turn, reduces the weight and yields a lighter bearing. Since the superconductors have inherently near-zero resistance, they are also expected to save power needed for operation considerably. Author

N91-21212*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
CHEMICAL SPRAY PYROLYSIS OF Tl-Ba-Ca-Cu-O HIGH-T(SUB c) SUPERCONDUCTORS FOR HIGH-FIELD BITTER MAGNETS c76
L. Pierre deRochemont, John G. Zhang, Michael R. Squillante, A. M. Hermann, H. M. Duan, Robert J. Andrews (Rome Air Development Center, Hanscom AFB, MA.), and Warren C. Kelliher *In its* Aerospace Applications of Magnetic Suspension Technology, Part 2 Mar. 1991 p 607-627 (For primary document see N91-21203 13-18)
Avail: NTIS HC/MF A17 CSCL 20K

The deposition of Tl-Ba-Ca-Cu-O thick films by spray pyrolyzing a Ba-Ca-Cu-O precursor film and diffusing thallium into the film to form the superconducting phase is examined. This approach was taken to reduce exposure to thallium and its health and safety hazards. The Tl-Ba-Ca-Cu-O system was selected because it has very attractive features which make it appealing to device and manufacturing engineering. Tl-Ba-Ca-Cu-O will accommodate a number of superconducting phases. This attribute makes it very forgiving to stoichiometric fluctuations in the bulk and film. It has excellent thermal and chemical stability, and appears to be relatively insensitive to chemical impurities. Oxygen is tightly bound into the systems, consequently there is no orthorhombic (conductor) to tetragonal (insulator) transition which would affect a component's lifetime. More significantly, the thallium based superconductors appear to have harder magnetic properties than the other high-Tc oxide ceramics. Estimates using magnetoresistance measurements indicate that at 77 K Tl2Ba2CaCu2O10 will have an upper critical field, H(sub c2) fo 26 Tesla for applied fields parallel to the c-axis and approximately 1000 Tesla for fields oriented in the a-b plane. Results to date have shown that superconducting films can be reproducibly deposited on 100 oriented MgO substrates. One film had a zero resistance temperature of 111.5 K. Furthermore, x ray diffraction analysis of the films showed preferential c-axis orientation parallel to the plane of the substrate. These results have now made it possible to consider the manufacture of a superconducting tape wire which can be configured into a topology useful for high-field magnet designs. The research which leads to the preparation of these films and plans for further development are reviewed. Author

N91-21213*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Engineering Science and Mechanics.
MODEL CORRELATION AND DAMAGE LOCATION FOR LARGE SPACE TRUSS STRUCTURES: SECANT METHOD DEVELOPMENT AND EVALUATION Final Report, 1 Feb. 1989 - 31 Jan. 1991
Suzanne Weaver Smith and Christopher A. Beattie Jan. 1991 60 p
(Grant NAG1-960)
(NASA-CR-188102; NAS 1.26:188102) Avail: NTIS HC/MF A04 CSCL 22B

On-orbit testing of a large space structure will be required to complete the certification of any mathematical model for the structure dynamic response. The process of establishing a mathematical model that matches measured structure response is referred to as model correlation. Most model correlation approaches have an identification technique to determine structural characteristics from the measurements of the structure response. This problem is approached with one particular class of identification techniques - matrix adjustment methods - which use measured data to produce an optimal update of the structure property matrix, often the stiffness matrix. New methods were developed for identification to handle problems of the size and complexity expected for large space structures. Further development and refinement of these secant-method identification algorithms were undertaken. Also, evaluation of these techniques is an approach for model correlation and damage location was initiated. Author

N91-21214*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
PRE-INTEGRATED STRUCTURES FOR SPACE STATION FREEDOM
Jonathan N. Cruz, Donald W. Monell, Philip Mutton (Lockheed Engineering and Sciences Co., Hampton, VA.), and Patrick A. Troutman Feb. 1991 268 p
(NASA-TM-102780; NAS 1.15:102780) Avail: NTIS HC/MF A12 CSCL 22B

An in-space construction (erectable) approach to assembling Freedom is planned but the increasing complexity of the station design along with a decrease in shuttle capability over the past several years has led to an assembly sequence that requires more resources (EVA, lift, volume) than the shuttle can provide given a fixed number of flights. One way to address these issues is to adopt a pre-integrated approach to assembling Freedom. A pre-integrated approach combines station primary structure and distributed systems into discrete sections that are assembled and checked out on the ground. The section is then launched as a single structural entity on the shuttle and attached to the orbiting station is then launched as a single structural entity on the shuttle and attached to the orbiting station with a minimum of EVA. The feasibility of a pre-integrated approach to assembling Freedon is discussed. The structural configuration, packaging, and shuttle integration of discrete pre-integrated elements for Freedom assembly are discussed. It is shown that the pre-integrated approach to assembly reduces EVA and increases shuttle margin with respect to mass, volume, and center of gravity limits when compared to the baseline Freedom assembly sequence. Author

N91-21215# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
DETERMINATION OF PITCH AND ROLL ANGLES WITH RESPECT TO A POINT ON EARTH SURFACE
Hans-Ulrich Pilchowski Nov. 1990 7 p Presented at the 1st Brazilian Symposium of Aerospace Technology, Sao Jose dos Campos, 17-31 Aug. 1990
(INPE-5206-PRE/1668) Avail: NTIS HC/MF A02

The necessary roll and pitch angles to reorient the attitude of a spacecraft that is requested to face an earth station separated from the sub-satellite point with a spot beam are evaluated. These angles are determined as a function of the local geographic coordinates of that earth surface point. Author

N91-21216# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
PROPOSED METHODOLOGY FOR THE STUDY OF URBAN ENVIRONMENT AND SPACE STRUCTURE IN METROPOLITAN AREA [PROPOSTA METODOLOGICA PARA O ESTUDO AMBIENTAL E DA ESTRUTURACAO DO ESPACO URBANO EM AREAS METROPOLITANAS]
Celina Foresti Nov. 1990 7 p In PORTUGUESE; ENGLISH summary Presented at the 6th Brazilian Symposium on Remote Sensing, Manaus, Brazil, 24-29 Jun. 1990
(INPE-5203-PRE/1665) Avail: NTIS HC/MF A02

The second generation satellites can be defined as mapping satellites due to their superior spatial, spectral and radiometric resolutions. Satellite data having these characteristics are useful in urban studies. The integration of data from the Geographic Information System (GIS) with different spatial and spectral resolutions than conventional data from topographic maps and other sources increases the possibility of producing new products that contain detail and precise information about an urban area. Here, a methodology of using remote sensing technology to study the urban environment is proposed. Results of a study carried out in the Sao Paulo metropolitan area are also discussed. Author

N91-21217# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
MATERIALS FOR AEROSPACE VEHICLES FRICTION DRAG REDUCTION SURFACES
Francisco Leme Galvao Nov. 1990 6 p Presented at the 1st

Brazilian Symposium of Aerospace Technology, Sao Jose dos Campos, Brazil, 27-31 Aug. 1990
(INPE-5188-PRE/1656) Avail: NTIS HC/MF A02

The frictional drag of aerospace vehicles is considered to result from the use of external surfaces with atomic level smoothness, obtained by epitaxial growth processes. The adsorption phenomena, the effects of the substratum atomic structure on adsorption forces, and the dynamics of the gas-solid surface interactions are discussed in order to identify the adequate material properties for such an application. It is concluded that some heavy transition metal halides and dichalcogenides, with Van der Waals layered crystalline structures, represent an adequate starting point for further research. Author

N91-21218# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
ATTITUDE CONTROL SIMULATION OF THE DATA COLLECTING SATELLITE: SCD2
Luiz Danilo D. Ferreira and Valdemir Carrara Oct. 1990 11 p Presented at the 1st Brazilian Symposium of Aerospace Technology, Sao Jose dos Campos, Brazil, 27-31 Aug. 1990
(INPE-5159-PRE/1638) Avail: NTIS HC/MF A03

The functions of the attitude control system (ACS) to be used in the second data collecting satellite (SCD2) are presented. The functions of the ACS include: (1) providing sensors signals that allow determination of the satellite attitude by processing in the ground; (2) damping the residual nutation of the spacecraft by using a nutation damper; (3) controlling the satellite spin rate by means of magnetic torque coils; and (4) controlling the spin axis direction using magnetic torque coils. Author

N91-21219# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
REQUIREMENTS AND TRADE-OFF STUDIES IN SATELLITE MECHANICAL ARCHITECTURE
Francisco LemeGalvao Nov. 1990 7 p Presented at the 1st Brazilian Symposium of Aerospace Technology, Aerospace Technology Inst. Sao Jose dos Campos, 27-31 Aug. 1990
(INPE-5186-PRE/1654) Avail: NTIS HC/MF A02

The requirements and trade-off studies used in the architectural concept design phase of the MECB-RSS1 satellite are presented. The main necessary requirements are presented with four satellite configurations designed to meet all of them. The desirable requirements are presented with the trade-off methodology used to choose between those different configurations. The present design phase configuration is also shown. Author

N91-21220 Kent Univ., Canterbury (England).
THE MICROMETEOROID IMPACT HAZARD IN SPACE: TECHNIQUES FOR DAMAGE SIMULATION BY PULSED LASERS AND ENVIRONMENTAL MODELLING
David C. Hill 1990 331 p
Avail: Univ. Microfilms Order No. BRDX90409

Pulsed lasers, generating high irradiances (approximately 10(exp 16) W/sq m), offer an alternative means of simulating hypervelocity microparticle impacts for a wide range of impactor mass/velocity combinations, allowing a large database of damage parameters to be built up over a relatively short time. Applications of the simulation technique are outlined for the study of the operation of electrically-active spacecraft subsystems (e.g., solar arrays) and optical subsystems when exposed to the near-earth orbital debris environment. Emphasis is placed on the extension of this technique, by varying laser radiation wavelength to maximize surface absorption, to different materials for space use. The impact damage hazard for various environments is generally assessed and the laser simulation technique applied within the context of the impact damage expected for various spacecraft materials.
Dissert. Abstr.

N91-21221* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
OVERCENTER COLLET SPACE STATION TRUSS FASTENER Patent
Philip L. Sheridan, inventor (to NASA) 12 Mar. 1991 10 p Filed 30 Apr. 1990 Supersedes N90-26859 (28 - 21, p 2966)
(NASA-Case-MSC-21504-1; US-Patent-4,998,842;
US-Patent-Appl-SN-516856; US-Patent-Class-403-252;
US-Patent-Class-403-171; US-Patent-Class-403-176;
US-Patent-Class-52-646; Int-Patent-Class-B25G-3/00) Avail: US Patent and Trademark Office CSCL 22B

A quick-connect fastener is arranged with a tubular body that is arranged to be engaged against the exterior surface of a hollow attachment fitting and coincidentally aligned with an opening in the fitting. A collet having normally-contracted fingers with outwardly-enlarged ends is operatively arranged in the body to be moved forwardly by an expander member mounted in the tubular body for advancing the collet fingers through the opening in the attachment fitting. Biasing means are arranged between the expander member and a toggle linkage in the tubular body which is selectively operated to urge the expander member forwardly into engagement with the collet fingers with an initial biasing force to advance their forward portions through the body opening and then expand them outwardly. The biasing means also provide a subsequent biasing force for retaining the collet members in their expanded positions once their enlarged forward end portions are on the opposite side of the body.
Official Gazette of the U.S. Patent and Trademark Office

N91-21222* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
ORBITAL DEBRIS SWEEPER AND METHOD Patent
Andrew J. Petro, inventor (to NASA) 12 Feb. 1991 7 p Filed 16 Feb. 1990 Supersedes N90-26860 (28 - 21, p 2966)
(NASA-Case-MSC-21534-1; US-Patent-4,991,788;
US-Patent-Appl-SN-480985; US-Patent-Class-244-158R;
US-Patent-Class-244-14; Int-Patent-Class-B24G-1/00) Avail: US Patent and Trademark Office CSCL 22B

An orbital debris sweeper is provided for removing particles from orbit which otherwise may impact and damage an orbiting spacecraft. The debris sweeper includes a central sweeper core which carries a debris monitoring unit, and a plurality of large area impact panels rotatable about a central sweeper rotational axis. In response to information from the debris monitoring unit, a computer determines whether individual monitored particles preferably impact one of the rotating panels or pass between the rotating panels. A control unit extends or retracts one or more booms which interconnect the sweeper core and the panels to change the moment of inertia of the sweeper and thereby the rotational velocity of the rotating panels. According to the method of the present invention, the change in panel rotational velocity increases the frequency of particles which desirably impact one of the panels and are thereby removed from orbit, while large particles which may damage the impact panels pass between the trailing edge of one panel and the leading edge of the rotationally succeeding panel.
Official Gazette of the U.S. Patent and Trademark Office

N91-21223*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
AEOSS DESIGN GUIDE FOR SYSTEM ANALYSIS ON ADVANCED EARTH-ORBITAL SPACECRAFT SYSTEMS
Hwa-Ping Lee Washington Dec. 1990 21 p
(NASA-TM-100772; NAS 1.15:100772) Avail: NTIS HC/MF A03 CSCL 22B

Advanced Earth Orbital Spacecraft System (AEOSS) enables users to project the requried power, weight, and cost for a generic earth-orbital spacecraft system. These variables are calculated on the component and subsystem levels, and then the system level. The included six subsystems are electric power, thermal control, structure, auxillary propulsion, attitude control, and communication, command, and data handling. The costs are computed using statistically determined models that were derived from the flown spacecraft in the past and were categorized into classes according to their functions and structural complexity. Selected design and performance analyses for essential components and subsystems are also provided. AEOSS has the feature permitting a user to

enter known values of these parameters, totally and partially, at all levels. All information is of vital importance to project managers of subsystems or a spacecraft system. AEOSS is a specially tailored software coded from the relational database program of the Acius; 4th Dimension with a Macintosh version. Because of the licensing agreement, two versions of the AEOSS documents were prepared. This version AEOSS Design Guide, is for users to exploit the full capacity of the 4th Dimension. It is for a user who wants to alter or expand the program structures, the program statements, and the program procedures. The user has to possess a 4th Dimension first. Author

N91-21224*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
AEOSS RUNTIME MANUAL FOR SYSTEM ANALYSIS ON ADVANCED EARTH-ORBITAL SPACECRAFT SYSTEMS
Hwa-Ping Lee Washington Dec. 1990 15 p
(NASA-TM-100773; NAS 1.15:100773) Avail: NTIS HC/MF A03 CSCL 22B

Advanced earth orbital spacecraft system (AEOSS) enables users to project the required power, weight, and cost for a generic earth-orbital spacecraft system. These variables are calculated on the component and subsystem levels, and then the system level. The included six subsystems are electric power, thermal control, structure, auxiliary propulsion, attitude control, and communication, command, and data handling. The costs are computed using statistically determined models that were derived from the flown spacecraft in the past and were categorized into classes according to their functions and structural complexity. Selected design and performance analyses for essential components and subsystems are also provided. AEOSS has the feature permitting a user to enter known values of these parameters, totally and partially, at all levels. All information is of vital importance to project managers of subsystems or a spacecraft system. AEOSS is a specially tailored software coded from the relational database program of the Acius' 4th Dimension witn a Macintosh version. Because of the licensing agreements, two versions of the AEOSS documents were prepared. This version, AEOSS Runtime Manual, is permitted to be distributed with a finite number of the restrictive 4D Runtime version. It can perform all contained applications without any programming alterations. Author

N91-21225*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
DYNAMIC AND CONTROL ASSESSMENT OF THE SPACE STATION FREEDOM PAYLOAD POINTING SYSTEM
David T. Shannon, Jr. Feb. 1991 35 p
(NASA-TM-101667; NAS 1.15:101667) Avail: NTIS HC/MF A03 CSCL 22B

An analysis of the proposed Space Station Freedom Payload Pointing System (PPS) was performed to assess its dynamic payload pointing capability in the dynamic environment of the Space Station Freedom (SSF). In addition, the stability and control the the SSF was examined to verify the capability of its control devices to accommodate the impact of PPS operations. An analysis of the PPS ability to provide continuous, accurate pointing was performed and compared to the program requirements specified in the 1988 Program Definition and Requirement Document (PDRD). Results indicated that the PPS was not able to perform within the program requirements during the worst case scenario of a shuttle hard docking maneuver to the port side SSF docking adapter. The PPS maintained marginal pointing accuracy during crew treadmill activity. The Space Station attitude control system easily accommodated all PPS operations simulated. The PPS caused a negligible impact on the SSF's control environment. Author

N91-21226# Los Alamos National Lab., NM.
NOTES ON SPACE, SATELLITES, AND SURVIVABILITY
G. H. Canavan Mar. 1991 14 p
(Contract W-7405-eng-36)
(DE91-009229; LA-11847-MS) Avail: NTIS HC/MF A03

The satellites most at risk in the near term are sensors and the brilliant pebbles for boost-phase defense. The availability of countermeasures for kinetic energy anti-satellites (ASATs) tends to downgrade them. Space-based interceptors and lasers are even less effective. Space mines appear to be the dominant space-based threat. Their main advantages are simplicity and low mass. If they can be forced to use decoys or cannot discriminate, that advantage is lost. For fundamental reasons discrimination should become more robust in time and combined defenses should become more effective. DOE

N91-21227# Naval Postgraduate School, Monterey, CA.
A PERTURBATION SOLUTION OF THE MAIN PROBLEM IN ARTIFICIAL SATELLITE THEORY M.S. Thesis
Christopher P. Sagovac Jun. 1990 35 p
(AD-A231560) Avail: NTIS HC/MF A03 CSCL 12/1

The main problem of artificial satellite theory is a restricted two body problem in which the Legendre Polynomial representation of the cylindrically symmetric potential contains only the first two terms. A generalized asymptotic expansion is used to obtain a first order approximation. The solution at the critical inclination is seen to be of a different type than at other inclinations. The solution is finite for all eccentricities and inclinations when suitably restricted in time. GRA

N91-21228# Air Force Inst. of Tech., Wright-Patterson AFB, OH.
ENTRY VEHICLE PERFORMANCE ANALYSIS AND ATMOSPHERIC GUIDANCE ALGORITHM FOR PRECISION LANDING ON MARS M.S. Thesis
Todd A. Dierlam Jun. 1990 170 p
(AD-A231585; AFIT/CI/CIA-90-131) Avail: NTIS HC/MF A08 CSCL 22/3

Future missions to Mars may require pin-point landing precision, possibly on the order of tens of meters. The ability to reach a target while meeting a dynamic pressure constraint to ensure safe parachute deployment is complicated at Mars by low atmospheric density, high atmospheric uncertainty, and the desire to employ only bank angle control. The vehicle aerodynamic performance requirements and guidance necessary for a 0.5 to 1.5 lift-to-drag ratio vehicle to maximize the achievable footprint while meeting the constraints are examined. A parametric study of the various factors related to entry vehicle performance in the mars environment is undertaken to develop general vehicle aerodynamic design requirements. The combination of low lift-to-drag ratio and low atmospheric density at Mars results in a large phugoid motion involving the dynamic pressure which complicates trajectory control. Vehicle ballistic coefficient is demonstrated to be the predominant characteristic affecting final dynamic pressure. A speed brake is shown to be ineffective at reducing the final dynamic pressure. An adaptive precision entry atmospheric guidance scheme is presented. The guidance uses a numeric predictor-corrector algorithm to control downrange, an azimuth controller to govern crossrange, and an analytic control law to reduce the final dynamic pressure. Guidance performance is tested against a variety of dispersions, and the results from selected test causes are presented. GRA

N91-22025# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
THE SUBMILLIMETER WAVE ASTRONOMY SATELLITE
Gary J. Melnick, A. Dalgarno, N. R. Erickson, G. G. Fazio, P. F. Goldsmith, Martin Harwit, D. J. Hollenbach, D. G. Koch, David A. Neufeld, and R. Schieder (Cologne Univ., Germany, F.R.) et al *In* ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 251-256 (For primary document see N91-21986 13-89)
Copyright Avail: NTIS HC/MF A17; EPD, ESTEC, Noordwijk, Netherlands, HC 80 Dutch guilders

N91-22050# Stockholm Observatory (Sweden).
MOSES: A PROPOSED SWEDISH SUBMILLIMETER SATELLITE FOR COMBINED ASTRONOMICAL AND ATMOSPHERIC OBSERVATIONS
Lennari Nordh, J. Askne, R. S. Booth, Andews Emrich, Urban

Frisk, A. Hjalmarsson, S. Jacobsson, Erik Kollberg, D. Murtagh (Stockholm Univ., Sweden), and G. Olofsson et al *In* ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 387-389 (For primary document see N91-21986 13-89)
Copyright Avail: NTIS HC/MF A17; EPD, ESTEC, Noordwijk, Netherlands, HC 80 Dutch guilders

19 SPACECRAFT INSTRUMENTATION

For related information see also *06 Aircraft Instrumentation* and *35 Instrumentation and Photography.*

No abstracts in this category.

20 SPACECRAFT PROPULSION AND POWER

Includes main propulsion systems and components, e.g., rocket engines; and spacecraft auxilliary power sources.

For related information see also *07 Aircraft Propulsion and Power, 28 Propellants and Fuels, 44 Energy Production and Conversion,* and *15 Launch Vehicles and Space Vehicles.*

N91-21229# Air Force Systems Command, Wright-Patterson AFB, OH. Foreign Technology Div.
THE ENERGY SOURCE ROCKET OF THE SOVIET UNION
17 Nov. 1988 12 p Transl. into ENGLISH from Hangtian (Peoples Republic of China), no. 1, 26 Jan. 1988 p 26-67
(AD-A224938; FTD-ID(RS)T-0886-88) Avail: NTIS HC/MF A03 CSCL 21/8

The Soviet Energy Source rocket is described. It has a nucleus body surrounded by four to eight rocket boosters. The core portion is equipped with four powerful H2/O2 engines. Each booster is equipped with a giant engine which burns kerosene and liquid O2. These engines ignite simultaneously upon launching. The Energy Source design and mission are also described. Author

N91-21230*# Thiokol Corp., Brigham City, UT. Space Operations.
FLIGHT SET 360L007 (STS-33) INSULATION COMPONENT. VOLUME 3: FINAL RELEASE Final Report
Steve Hicken Aug. 1990 204 p
(Contract NAS8-30490)
(NASA-CR-184091; NAS 1.26:184091; TWR-17546-Vol-3; L623-FY91-M020) Avail: NTIS HC/MF A10 CSCL 21H

Volume 3 of this postfire report deals with the insulation component of the RSRM. The report is released twice for each flight set. The interim release contract date is on or before 60 days after the last field joint or nozzle to case joint is disassembled at KSC and contain the results of the KSC visual evaluation. The data contained in Volume 3 interim release supersedes the insulation data presented in the KSC 10 day report. The final release contract data is on or before 60 days after the last factory joint is disassembled at the Clearfield H-7 facility and contains the results of all visual evaluations and a thermal safety factor analysis. The data contained in the Volume 3 final release supersedes the interim release and the insulation data presented in the Clearfield 10 day report. Author

N91-21231*# Thiokol Corp., Brigham City, UT. Space Operations.
FLIGHT MOTOR SET 360T010 (STS-31R). VOLUME 1: SYSTEM OVERVIEW Final Report
Diane Garecht Oct. 1990 163 p Original contains color illustrations
(Contract NAS8-30490)
(NASA-CR-184104; NAS 1.26:184104; TWR-17549-Vol-1; Publ-910415-Vol-1) Avail: NTIS HC/MF A08; 1 functional color page CSCL 21H

Flight motor set 360T010 was launched at approximately 7:34 a.m. CST (090:114:12:33:50.990 GMT) on 24 Apr. 1990 after one launch attempt (attempt on 10 Apr. 1990 was scrubbed following an indication of erratic operation of the Orbiter No. 1 Auciliary Power Unit No. 1). There were no problems with the solid rocket motor launches, overall motor performance was excellent. There were no debris concerns from either motor. Nearly all ballistic contract end item specification parameters were verified with the exception of ignition interval, pressure rise rate, and ignition time thrust imbalance. These could not be verified due to elimination of developmental flight instrumentation on 360L004 (STS-30R) and subsequent, but low sample rate data that were available showed nominal propulsion performance. All ballistic and mass property parameters that could be assessed closely matched the predicted values and were well within the required contract end item specification levels. All field joint heaters and igniter joint heaters performed without anomalies. Evaluation of the ground environment instrumentation measurements again verified thermal model analysis data and showed agreement with predicted environmental effects. No launch commit criteria violations occurred. Postflight inspection again verified nominal performance of the insulation, phenolics, metal parts, and seals. Postflight evaluation indicated both nozzles performed as expected during flight. All combustion gas was contained by insulation in the field and case-to-nozzle joints. Author

N91-21232*# Pratt and Whitney Aircraft, West Palm Beach, FL. Government Engine Business.
LARGE LIQUID ROCKET ENGINE TRANSIENT PERFORMANCE SIMULATION SYSTEM Final Report
J. R. Mason and R. D. Southwick 1991 208 p
(Contract NAS8-36994)
(NASA-CR-184099; NAS 1.26:184099) Avail: NTIS HC/MF A10 CSCL 21H

A simulation system, ROCETS, was designed and developed to allow cost-effective computer predictions of liquid rocket engine transient performance. The system allows a user to generate a simulation of any rocket engine configuration using component modules stored in a library through high-level input commands. The system library currently contains 24 component modules, 57 sub-modules and maps, and 33 system routines and utilities. FORTRAN models from other sources can be operated in the system upon inclusion of interface information on comment cards. Operation of the simulation is simplified for the user by run, execution, and output processors. The simulation system makes available steady-state trim balance, transient operation, and linear partial generation. The system utilizes a modern equation solver for efficient operation of the simulations. Transient integration methods include integral and differential forms for the trapezoidal, first order Gear, and second order Gear corrector equations. A detailed technology test bed engine (TTBE) model was generated to be used as the acceptance test of the simulation system. The general level of model detail was that reflected in the Space Shuttle Main Engine DTM. The model successfully obtained steady-state balance in main stage operation and simulated throttle transients, including engine starts and shutdown. A NASA FORTRAN control model was obtained, ROCETS interface installed in comment cards, and operated with the TTBE model in closed-loop transient mode. Author

N91-21233*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
COOLING OF IN-SITU PROPELLANT ROCKET ENGINES FOR MARS MISSION M.S. Thesis - Cleveland State Univ.
Elizabeth S. Armstrong Jan. 1991 98 p
(NASA-TM-103729; E-5963; NAS 1.15:103729) Avail: NTIS HC/MF A05 CSCL 21H

One propulsion option of a Mars ascent/descent vehicle is multiple high-pressure, pump-fed rocket engines using in-situ propellants, which have been derived from substances available

on the Martian surface. The chosen in-situ propellant combination for this analysis is carbon monoxide as the fuel and oxygen as the oxidizer. Both could be extracted from carbon dioxide, which makes up 96 percent of the Martian atmosphere. A pump-fed rocket engine allows for higher chamber pressure than a pressure-fed engine, which in turn results in higher thrust and in higher heat flux in the combustion chamber. The heat flowing through the wall cannot be sufficiently dissipated by radiation cooling and, therefore, a regenerative coolant may be necessary to avoid melting the rocket engine. The two possible fluids for this coolant scheme, carbon monoxide and oxygen, are compared analytically. To determine their heat transfer capability, they are evaluated based upon their heat transfer and fluid flow characteristics. Author

N91-21234*# Pratt and Whitney Aircraft, West Palm Beach, FL. Government Engines and Space Propulsion Div.
ADVANCED EXPANDER TEST BED PROGRAM Final Annual Technical Progress Report, 27 Apr. - 31 Dec. 1990
A. I. Masters and J. C. Mitchell Apr. 1991 64 p
(Contract NAS3-25960)
(NASA-CR-187082; NAS 1.26:187082; FR-21319-1) Avail: NTIS HC/MF A04 CSCL 21H

The Advanced Expander Test Bed (AETB) is a key element in NASA's Chemical Transfer Propulsion Program for development and demonstration of expander cycle oxygen/hydrogen engine technology component technology for the next space engine. The AETB will be used to validate the high-pressure expander cycle concept, investigate system interactions, and conduct investigations of advanced missions focused components and new health monitoring techniques. The split-expander cycle AETB will operate at combustion chamber pressures up to 1200 psia with propellant flow rates equivalent to 20,000 lbf vacuum thrust. Y.S.

N91-21235*# Rockwell International Corp., Canoga Park, CA. Rocketdyne Div.
HEAVY HYDROCARBON MAIN INJECTOR TECHNOLOGY PROGRAM Final Report, Apr. 1987 - Jan. 1991
H. A. Arbit, L. M. Tuegel, and F. E. Dodd Apr. 1991 387 p Original contains color illustrations
(Contract NAS8-36369)
(NASA-CR-188082; NAS 1.26:188082; RI/RD-91-118) Avail: NTIS HC/MF A17; 6 functional color pages CSCL 21H

The Heavy Hydrocarbon Main Injector Program was an analytical, design, and test program to demonstrate an injection concept applicable to an Isolated Combustion Compartment of a full-scale, high pressure, LOX/RP-1 engine. Several injector patterns were tested in a 3.4-in. combustor. Based on these results, features of the most promising injector design were incorporated into a 5.7-in. injector which was then hot-fire tested. In turn, a preliminary design of a 5-compartment 2D combustor was based on this pattern. Also the additional subscale injector testing and analysis was performed with an emphasis on improving analytical techniques and acoustic cavity design methodology. Several of the existing 3.5-in. diameter injectors were hot-fire tested with and without acoustic cavities for spontaneous and dynamic stability characteristics. Author

N91-21236*# Cincinnati Univ., OH. Dept. of Aerospace Engineering and Engineering Mechanics.
SPACE VEHICLE PROPULSION SYSTEMS: ENVIRONMENTAL SPACE HAZARDS Final Report
P. J. Disimile and G. K. Bahr Sep. 1990 60 p
(Grant NAG3-948)
(NASA-CR-188094; NAS 1.26:188094) Avail: NTIS HC/MF A04 CSCL 21H

The hazards that exist in geolunar space which may degrade, disrupt, or terminate the performance of space-based LOX/LH2 rocket engines are evaluated. Accordingly, a summary of the open literature pertaining to the geolunar space hazards is provided. Approximately 350 citations and about 200 documents and abstracts were reviewed; the documents selected give current and quantitative detail. The methodology was to categorize the various space hazards in relation to their importance in specified regions of geolunar space. Additionally, the effect of the various space hazards in relation to spacecraft and their systems were investigated. It was found that further investigation of the literature would be required to assess the effects of these hazards on propulsion systems per se; in particular, possible degrading effects on exterior nozzle structure, directional gimbals, and internal combustion chamber integrity and geometry. Author

N91-21237# Institut Franco-Allemand de Recherches, Saint-Louis (France).
STUDY OF THE ABSORPTION LINES WIDENED BY THE EFFECT OF PRESSURE, EMITTED BY THE COMBUSTION GASES OF PROPULSIVE POWDERS [UNTERSUCHUNGEN AN DRUCKVERBREITERTEN ABSORPTIONSLINIEN HEISSER PULVERGASSTROEMUNGEN]
H. Mach, U. Werner, and H. Masur 10 Oct. 1989 44 p In GERMAN
(ISL-R-124/89; ETN-91-98991) Avail: NTIS HC/MF A03

The continuous spectra obtained by the combustion of explosive substances at high pressures is studied in the case of absorption lines from the resonance of alkaline components. The Na resonance line (wave length equals to 589 nm) was analyzed by means of a cylindrical combustion chamber for pressures varying up 40 to 100 MPa and temperatures in the area 1600 to 2500 K. The line broadness, the asymmetry factor and the interval were measured as a function of time, pressure or gas density. It is concluded that there is a widening due to a Van der Waals interaction and a time dependent thinning of the temperature boundary layer. ESA

N91-21238# Federal Aviation Administration, Atlantic City, NJ.
MODEL ROCKETRY HAZARD STUDY
Charles C. T. Chen and Caesar A. Caiafa Mar. 1991 23 p
(DOT/FAA/CT-TN90/28) Avail: NTIS HC/MF A03

The potential hazard was evaluated to an approaching or departing aircraft from a collision with a model rocket. Typically, these rockets have a gross weight of 1.5 kg (53 ounces) or less and carry a maximum of 0.125 kg (4.4 ounces) of propellant. The potential damage to jet transports, commuter aircraft, general aviation aircraft, and rotorcraft resulting from an impact with these rockets is determined. Author

N91-21239*# Computational Mechanics Co., Austin, TX.
SOLID ROCKET BOOSTER INTERNAL FLOW ANALYSIS BY HIGHLY ACCURATE ADAPTIVE COMPUTATIONAL METHODS Final Report
C. Y. Huang, W. Tworzydlo, J. T. Oden, J. M. Bass, C. Cullen, and S. Vadaketh 15 Mar. 1991 126 p
(Contract NAS8-37682)
(NASA-CR-184141; NAS 1.26:184141; TR-91-05) Avail: NTIS HC/MF A07 CSCL 21H

The primary objective of this project was to develop an adaptive finite element flow solver for simulating internal flows in the solid rocket booster. Described here is a unique flow simulator code for analyzing highly complex flow phenomena in the solid rocket booster. New methodologies and features incorporated into this analysis tool are described. Author

N91-21240*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
POWER TECHNOLOGIES AND THE SPACE FUTURE
Karl A. Faymon, J. Stuart Fordyce, and Henry W. Brandhorst, Jr. Apr. 1991 24 p Submitted for publication
(NASA-TM-103649; E-5835; NAS 1.15:103649) Avail: NTIS HC/MF A03 CSCL 21H

Advancements in space power and energy technologies are critical to serve space development needs and help solve problems on Earth. The availability of low cost power and energy in space will be the hallmark of this advance. Space power will undergo a dramatic change for future space missions. The power systems which have served the U.S. space program so well in the past will not suffice for the missions of the future. This is especially

true if the space commercialization is to become a reality. New technologies, and new and different space power architectures and topologies will replace the lower power, low-voltage systems of the past. Efficiencies will be markedly improved, specific powers will be greatly increased, and system lifetimes will be markedly extended. Space power technology is discussed - its past, its current status, and predictions about where it will go in the future. A key problem for power and energy is its cost of affordability. Power must be affordable or it will not serve future needs adequately. This aspect is also specifically addressed. Author

N91-21241# Naval Postgraduate School, Monterey, CA.
PERFORMANCE OF SMALL THRUSTERS AND PROPULSION SYSTEMS M.S. Thesis
Thomas E. Saunders Mar. 1990 81 p
(AD-A231482) Avail: NTIS HC/MF A05 CSCL 13/10

Performance tests of the longitudinal and lateral propulsion devices for use on the Naval Postgraduate School (NPS) Autonomous Underwater Vehicle (AUV) II are presented. The propulsion requirements for the AUV are discussed and a brief review of the theoretical performance of propulsors is presented. The test procedures used to determine the operating range characteristics of the candidate propulsion devices are described and the results are compared with those obtained theoretically as well as with the parameters of large marine propulsion systems. The results of simulations of longitudinal motion using a non-linear model of the AUV are documented, providing an initial estimate of vehicle acceleration/deceleration performance. GRA

23 CHEMISTRY AND MATERIALS (GENERAL)

No abstracts in this category.

24 COMPOSITE MATERIALS

Includes physical, chemical, and mechanical properties of laminates and other composite materials.

For ceramic materials see *27 Nonmetallic Materials.*

N91-21242*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
A NOVEL METHOD OF TESTING THE SHEAR STRENGTH OF THICK HONEYCOMB COMPOSITES
A. J. Hodge and A. T. Nettles Mar. 1991 16 p
(NASA-TP-3108; NAS 1.60:3108) Avail: NTIS HC/MF A03 CSCL 11D

Sandwich composites of aluminum and glass/phenolic honeycomb core were tested for shear strength before and after impact damage. The assessment of shear strength was performed in two ways; by four point bend testing of sandwich beams and by a novel double lap shear (DLS) test. This testing technique was developed so smaller specimens could be used, thus making the use of common lab scale fabrication and testing possible. The two techniques yielded similar data. The DLS test gave slightly lower shear strength values of the two methods but were closer to the supplier's values for shear strength. Author

N91-21243*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
MECHANICAL BEHAVIOR OF FIBER REINFORCED SiC/RBSN CERAMIC MATRIX COMPOSITES: THEORY AND EXPERIMENT
Abhisak Chulya (Cleveland State Univ., OH.), John P. Gyekenyesi, and Ramakrishna T. Bhatt 1991 30 p Presented at the 36th International Gas Turbine and Aeroengine Congress and Exposition, Orlando, FL, 3-6 Jun. 1991; sponsored by ASME Prepared in cooperation with Army Aviation Systems Command, Cleveland, OH
(Contract NCC3-81; DA Proj. 1L1-61102-AH-45)
(NASA-TM-103688; E-5907; NAS 1.15:103688;
AVSCOM-TR-91-C-004) Avail: NTIS HC/MF A03 CSCL 11D

The mechanical behavior of continuous fiber reinforced SiC/RBSN (Reaction Bonded Silicon Nitride) composites with various fiber contents is evaluated. Both catastrophic and noncatastrophic failures are observed in tensile specimens. Damage and failure mechanisms are identified via in-situ monitoring using NDE (nondestructive evaluation) techniques through the loading history. Effects of fiber/matrix interface debonding (splitting) parallel to fibers are discussed. Statistical failure behavior of fibers is also observed, especially when the interface is weak. Micromechanical models incorporating residual stresses to calculate the critical matrix cracking strength, ultimate strength, and work of pull-out are reviewed and used to predict composite response. For selected test problems, experimental measurements are compared to analytical predictions. Author

N91-21244# Oxford Univ. (England). Dept. of Engineering Science.
MODELLING OF THE IMPACT RESPONSE OF FIBRE-REINFORCED COMPOSITES Final Report
Y. L. Li, J. Harding, and C. Ruiz 1990 147 p
(Grant AF-AFOSR-0129-87)
(OUEL-1863/90; ETN-91-98961) Avail: NTIS HC/MF A07

The work carried out over the course of a three year period in three different areas is summarized. Experimental techniques for determining the impact mechanical properties of fiber reinforced epoxy laminates are studied. The experimental results obtained from the tensile, compressive and interlaminar shear properties of woven reinforced carbon/epoxy, glass/epoxy, Kevlar/epoxy and hybrid carbon-glass/epoxy laminates are analyzed. Attempts at modeling the experimentally observed behavior are described. For individual titles, see N91-21245 through N91-21250.

N91-21245# Oxford Univ. (England). Dept. of Engineering Science.
EFFECT OF STRAIN RATE ON THE THROUGH-THICKNESS ELASTIC PROPERTIES OF WOVEN LAMINATES
Y. L. Li, J. Harding, and M. E. C. Taylor *In its* Modelling of the Impact Response of Fibre-Reinforced Composites 1990 27 p (For primary document see N91-21244 13-24)
Avail: NTIS HC/MF A07

Woven carbon, woven glass and hybrid woven carbon/woven glass epoxy laminates are prepared and tested in tension at a quasistatic and an impact rate of strain. The tensile load is applied normal to the interlaminar plane and strain gauge rosettes are used to determine the corresponding strains in the loading and transverse directions. From the data obtained the effect of strain rate on the tensile elastic modulus in the through thickness direction and on the values of Poisson's ratio for planes normal to the warp and weft reinforcing directions is determined. ESA

N91-21246# Oxford Univ. (England). Dept. of Engineering Science.
A NEW TYPE OF SHEAR SPECIMEN FOR MEASURING THE INTERLAMINAR SHEAR STRENGTH UNDER IMPACT LOADING
Y. L. Li, J. Harding, and C. Ruiz *In its* Modelling of the Impact Response of Fibre-Reinforced Composites 1990 30 p (For primary document see N91-21244 13-24)
Avail: NTIS HC/MF A07

Two new designs of shear specimen, suitable for use in the Hopkinson bar to measure the interlaminar shear strength in woven reinforced composite materials at different strain rates, are presented. The finite element method is used to calculate the shear stress distribution along the shear plane. The results show a more uniform shear stress in the second specimen design. The introduction of a small notch to initiate shear failure on a prechosen plane results in a small stress concentration near the notch tip.

This stress concentration is much smaller than for the first design, a double lap shear specimen, and for other specimens previously used to measure impact shear strength. ESA

N91-21247# Oxford Univ. (England). Dept. of Engineering Science.
THE INTERLAMINAR SHEAR STRENGTH OF WOVEN CARBON, WOVEN GLASS AND WOVEN CARBON/GLASS HYBRID LAMINATES UNDER STATIC AND IMPACT LOADING
Y. L. Li, J. Harding, and M. E. C. Taylor *In its* Modelling of the Impact Response of Fibre-Reinforced Composites 1990 63 p Previously announced as N91-14423 (For primary document see N91-21244 13-24)
Avail: NTIS HC/MF A07

Double lap shear specimens are prepared from woven carbon and woven glass plies and the shear strength determined on the interlaminar plane between two carbon plies, two glass plies and one carbon and one glass ply. Specimens are prepared from dry woven mats hand laid up in an epoxy resin matrix. All carbon specimens are prepared from a satin weave carbon/epoxy prepreg. Tests are performed under static loading using an Instron testing machine and under impact loading using a tensile split Hopkinson bar. The results show that the interlaminar shear stress is highest for the specimens prepared from the carbon/epoxy prepreg under both static loading and impact loading. For the specimens prepared from dry woven mats and epoxy resin under static loading the interlaminar shear strength is highest for the hybrid hand layup and is lowest for the all glass hand layup. For all the carbon hand layup the interlaminar shear strength is slightly less than that of the hybrid specimen. The results show that interlaminar shear strength is remarkably strain rate dependent. The interlaminar shear strength increases by about 72.6 pct. under impact loading for all glass material, 70.4 pct. for all carbon material and 55.6 pct. for the hybrid material. Under impact loading the interlaminar strength is highest for the all carbon hand layup and is lowest for all glass hand layup. For the hybrid specimen it is slightly less than for the all carbon hand layup. ESA

N91-21248# Oxford Univ. (England). Dept. of Engineering Science.
ANALYSIS OF FAILURE IN WOVEN CARBON/EPOXY LAMINATES UNDER QUASI-STATIC AND IMPACT LOADING
J. Harding and Y. L. Li *In its* Modelling of the Impact Response of Fibre-Reinforced Composites 1990 38 p (For primary document see N91-21244 13-24)
Avail: NTIS HC/MF A07

A finite element method is used to determine the tensile stress concentration factors and the interlaminar shear stresses close to a failed ply in a woven carbon reinforced epoxy laminate under tensile loading. Ply failure is modeled by a reduction in stiffness in the loading direction. Different reductions in stiffness, representing either matrix breakup or fiber tow fracture are studied and the redistributed stress system, for the case where delamination follows initial ply failure, is determined. The results of the theoretical analyses are discussed in the light of experimental data from tensile tests on a similar laminate at both a quasistatic and an impact rate of loading and the failure process at each rate of strain is described. ESA

N91-21249# Oxford Univ. (England). Dept. of Engineering Science.
STRESS WAVE PROPAGATION IN HYBRID COMPOSITE MATERIALS
Y. L. Li (Northwestern Polytechnical Univ., Xian, China), C. Ruiz, and J. Harding *In its* Modelling of the Impact Response of Fibre-Reinforced Composites 1990 24 p (For primary document see N91-21244 13-24)
Avail: NTIS HC/MF A07

The dynamic response, in particular, the interlaminar shear stress, in three layer symmetrical hybrid composites is studied using the shear lag model. Theoretical solutions for four different types of loading are obtained. Numerical examples are given for the step loading case and the results obtained show good agreement with those determined using the finite element method. The interlaminar shear stress is composed of static and dynamic parts and the peak interlaminar shear stress, which occurs at the loading end under the step uniform pressure loading, is dominated by the static stress and is dependent on the stiffness ratio between the center and the outer plies. This agrees with the solution for the infinite length case. ESA

N91-21250# Oxford Univ. (England). Dept. of Engineering Science.
MECHANICAL BEHAVIOUR OF COMPOSITE MATERIALS UNDER IMPACT LOADING
J. Harding *In its* Modelling of the Impact Response of Fibre-Reinforced Composites 1990 17 p (For primary document see N91-21244 13-24)
Avail: NTIS HC/MF A07

The problems of characterizing the mechanical behavior of composite materials under impact loading are discussed. Techniques for determining such behavior for tensile, compressive and shear loading are described and some qualitative conclusions are drawn from the results obtained. It is concluded that care is required in evaluating the data obtained if true material properties are to be derived. More work is needed if particular damage processes are to be isolated and their individual rate dependence determined. ESA

N91-21251# Washington State Univ., Pullman.
ACOUSTIC EMISSION-FRACTURE STRENGTH RELATIONS FOR Al/Gr COMPOSITES
J. D. Easterday, C. H. Henager, Jr., M. A. Friesel, R. H. Jones, and M. T. Smith (Pacific Northwest Lab., Richland, WA.) Jun. 1990 14 p Presented at the Annual Meeting and Exhibition of the Minerals, Metals and Materials Society, New Orleans, 17-21 Feb. 1991
(Contract DE-AC06-76RL-01830)
(DE91-009106; PNL-SA-18545; CONF-910202-7) Avail: NTIS HC/MF A03

It has been demonstrated that strength degradation in Al/Gr fiber-reinforced composites can be detected by acoustic emission (AE) while being strained within the elastic range. This nondestructive method of distinguishing between good and poor metal-matrix composites may prove useful as a quality control tool. Specimens of 6061 Al/P100 graphite fiber-reinforced composite in the as-received and heat-treated conditions were monitored for AE response while being strained to 0.08 percent. Heat treatments were chosen to produce different quantities of aluminium carbide Al4, C3 at the fiber/matrix interface. The increase in aluminum carbide reaction product caused a corresponding decrease in DEN failure strength. Examination of the number of AE events versus amplitude and stress, microstructures and fracture modes all provided insight to possible AE sources. Identification of these sources has the potential to provide information on degradation and/or failure mechanism of metal-matrix composites. DOE

N91-21252*# Sverdrup Technology, Inc., Brook Park, OH.
FLAT TENSILE SPECIMEN DESIGN FOR ADVANCED COMPOSITES Final Report
Dennis W. Worthem Nov. 1990 19 p Original contains color illustrations
(Contract NAS3-25266)
(NASA-CR-185261; E-5602; NAS 1.26:185261) Avail: NTIS HC/MF A03; 2 functional color pages CSCL 11D

Finite element analyses of flat, reduced gage section tensile specimens with various transition region contours were performed. Within dimensional constraints, such as maximum length, tab region width, gage width, gage length, and minimum tab length, a transition contour radius of 41.9 cm produced the lowest stress values in the specimen transition region. The stresses in the transition region were not sensitive to specimen material properties. The stresses in the tab region were sensitive to specimen composite and/or tab material properties. An evaluation of stresses with different specimen composite and tab material combinations must account

for material nonlinearity of both the tab and the specimen composite. Material nonlinearity can either relieve stresses in the composite under the tab or elevate them to cause failure under the tab. Author

N91-21253 ESDU International Ltd., London (England).
DELAMINATION AND FREE EDGE STRESSES IN LAMINATED PLATES SUBJECTED TO CONSTANT UNIAXIAL STRAIN (COMPUTER PROGRAM) Abstract Only
Jan. 1991 76 p
(ESDU-90021; ISBN-0-85679-747-2; ISSN-0141-4097; ISSN-0958-0360) Avail: ESDU

ESDU 90021 gives the FORTRAN listing of a program to calculate the through-thickness stresses at and near the free edges of laminated plates. A quadratic average stress failure criterion is suggested to predict delamination and the interlayer at which it occurs. It is based on the free edge stresses averaged over a distance from the edge; guidance is given on the choice of averaging distance. The predicted onset of delamination is compared with test results extracted from the literature. The theory, which is presented in detail, assumes the plate is made from thin orthotropic homogeneous layers with perfect bonding between them. The layers may have different material elastic properties, thicknesses, and orientations of their principal axes of orthotropy but must form a balance lay-up about the mid-plane of the plate. The program handles up to 50 different layer types and up to 500 layers, but both of those numbers can be increased. The input to and output from the program are described with the aid of two fully worked examples. Details of program testing carried out are included, and warning messages that may be provided are explained. Results for the stresses are compared graphically with test results extracted from the literature for finite element calculations of the edge stresses on six different plate lay-ups. ESDU

N91-21254# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.). Abt. Strukturberechnung.
THERMOMECHANICS TASKS AND APPLICATIONS
Dieter Petersen Aug. 1990 24 p
(DLR-Mitt-90-14; ISSN-0176-7739; ETN-91-99038) Avail: NTIS HC/MF A03; DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 12.50 DM

The field of thermomechanical activities of the Institute for Structural Mechanics in numerical and experimental analysis of aerospace structures is presented. After discussing the implications and prerequisites, knowledge of load spectra and material characteristics, structural concepts for heat protection during reentry, orbital application, and use of carbon fiber reinforced polymers in airplanes are examined. From these concepts the tasks of thermal and structural analysis as well as the testing requirements are deduced. ESA

N91-21255*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
REDISTRIBUTION OF PARTICULATES ON A PAYLOAD DURING FLIGHT ASCENT
John J. Scialdone Apr. 1991 17 p
(NASA-TM-104539; Rept-91B00060; NAS 1.15:104539) Avail: NTIS HC/MF A03 CSCL 11D

The dislodgement, venting, and redeposition of particles on a surface caused by the vibroacoustic, gravitational, and aerodynamic forces are estimated and the resulting areal obscurations of the surface are calculated. The data on particle redistribution estimated to occur during a Shuttle launch are employed to estimate the obscuration of a spacecraft's star tracker, as it is carried into orbit by the Shuttle. The approach used for that calculation is generalized so that it can be employed for other applications where either the Shuttle or an Expendable Launch Vehicle (ELV) is employed for launch. Approaches for evaluating particle redistribution for other applications and for general use are indicated. Author

N91-21256# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
MATERIAL PROPERTIES OF SILICON CARBIDE FIBERS WITH CONTINUOUSLY APPLIED SOL-GEL ALUMINA COATINGS M.S. Thesis
Christian C. Daehnick Dec. 1990 146 p
(AD-A230825; AFIT/GA/ENY/90D-03) Avail: NTIS HC/MF A07 CSCL 11/2

An investigation was conducted to determine the effect of non-alpha-alumina coatings applied under varying conditions on some of the properties of silicon carbide fibers. Limited characterization of the coating by optical, scanning electron, and transmitted electron microscopy as well as energy-dispersive x-ray analysis was performed. Tensile tests were used to determine changes in elastic modulus, ultimate strength, and strain to failure of the coated fibers relative to uncoated fibers. The coatings were found to lower the mean value of the measured properties as their thickness increased, but the measurements were not accurate enough to determine if this corresponded to a simple rule of mixtures relationship or not. For the same reason, no definitive statements can be made about the properties of the coating itself. A two-dimensional plane-strain analysis incorporating thermal residual stresses was also performed to determined possible failure points. GRA

N91-21257# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
IMPACT DAMAGE IN CURVED GRAPHITE/EPOXY PANELS WITH CLAMPED EDGES M.S. Thesis
Ronald B. Perry Dec. 1990 191 p
(AD-A230853; AFIT/GAE/ENY/90D-19) Avail: NTIS HC/MF A09 CSCL 11/4

Graphite/epoxy curved cylindrical panels were impacted in the center by an impact machine capable of measuring load during the test. Load, deflection and strain as functions of time were measured for six symmetric layup configurations for impact energies of 0.5 to 4.5 ft-lb. Damage was produced in all panels for certain impact energies. The extent and location of damage was determined from C-scans and optical microscopy of panel cross-sections. The cross-sections indicated that both delamination and transverse cracking contribute to internal damage. An in-house nonlinear finite element code was used to predict the panel deflections and stresses. The analysis produced good results in predicting the panel deflection and indicated transverse failure stresses were present in the panel center region. The deflections indicated that the panel was in between simply supported and clamped boundary conditions, with good agreement obtained for hinged support at each edge. GRA

N91-21258# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
FRACTURE TOUGHNESS OF UNIDIRECTIONAL FIBER REINFORCED CERAMIC COMPOSITES IN MODE 2 UTILIZING LASER INTERFEROMETRY M.S. Thesis
Joseph W. Truskowski Dec. 1990 113 p
(AD-A231027; AFIT/GAE/ENY/90D-31) Avail: NTIS HC/MF A06 CSCL 09/3

A laser interferometry technique to measure crack opening displacement was developed and applied to end notched flexure specimens of a Corning Glass Works 1723 glass matrix with silicon carbide fibers. The laser interferometer displacement gauge monitored the crack opening displacement (COD) at the location of a support while specimens were subjected to Mode 2 (forward shear) cracking at room temperature via three point bend tests on a standard Instron Compression machine. Vertical displacement was measured at the center of the test specimen using a linear variable differential transformer. Load verses displacement curves were generated for both the LVDT displacement and the COD. The COD curve showed a marked improvement in determining the onset of crack growth. From the enhanced critical load determination, the materials fracture toughness in Mode 2, GI.Ic was calculated for varying crack lengths. The calculations provided

estimates with a variance of only 10 percent from the mean thus illustrating the utility of this procedure. GRA

N91-21259# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
TRANSVERSE CRACKING IN A FIBER REINFORCED CERAMIC MATRIX COMPOSITE M.S. Thesis
Steven E. Bachmann Dec. 1990 112 p
(AD-A231029; AFIT/GAE/ENY/90D-2) Avail: NTIS HC/MF A06 CSCL 11/4

The purpose of this study was to investigate the transverse cracking behavior of a fiber reinforced ceramic matrix composite. The major objectives were to determine the crack initiation stress and the minimum transverse crack spacing for different cross-ply lay-ups of SiC/1723, to provide explanation for the differences in the performance of the lay-ups, and to compare the test results to available theoretical models and to other composite systems. The thickness of the transverse ply was found to have a great effect on the transverse cracking behavior of laminates. The saturation crack spacing decreased as the transverse ply thickness was decreased. Classical laminate theory was used to predict crack initiation stresses and modulus of elasticity. A crack spacing theory based on shear lag analysis was applied. Comparisons were made to glass/epoxy and graphite/epoxy systems. GRA

N91-21260# Johns Hopkins Univ., Baltimore, MD.
THE OVERALL RESPONSE OF COMPOSITE MATERIALS UNDERGOING LARGE ELASTIC DEFORMATIONS Final Report, 1 Apr. 1989 - 31 Aug. 1990
Pedro P. Castaneda 30 Oct. 1990 66 p
(Grant AF-AFOSR-0288-89; AF Proj. 2302)
(AD-A231637; AFOSR-91-0041TR) Avail: NTIS HC/MF A04 CSCL 11/4

The main goal of this project is to estimate theoretically the overall or effective constitutive properties of nonlinear composite materials undergoing large deformations. Two types of large deformations are of interest: large elastic deformations, and large viscous deformations. The proposed method is to apply variational principles that are under development to characterize the range of the effective properties given partial statistical information about the microstructure (such as the volume fractions of the phases). For some particular microstructures of interest exact estimates may be given. GRA

25 INORGANIC AND PHYSICAL CHEMISTRY

Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry.

For related information see also *77 Thermodynamics and Statistical Physics.*.

N91-21261# Rice Univ., Houston, TX. Dept. of Chemistry.
ULTRAVIOLET PHOTOELECTRON SPECTRA OF GALLIUM ARSENIDE CLUSTERS Interim Report
C. Jin, K. J. Taylor, J. Conceicao, and R. E. Smalley 23 Jul. 1990 18 p
(Contract N00014-88-K-0553)
(AD-A224927; TR-3) Avail: NTIS HC/MF A03 CSCL 07/4

The ultraviolet photoelectron spectra (UPS) of mass-selected negative gallium arsenide cluster ions in the 2 to 50 atom size range was measured with a photon energy of 7.9 eV. The measured photodetachment thresholds displayed a strong even/odd oscillation through the largest clusters in this range, suggesting the presence of a substantial HOMO-LUMO gap in the corresponding neutral clusters which evolves to the band gap of bulk GaAs crystals. GRA

N91-21262# SRI International Corp., Menlo Park, CA.
LASER PROBES OF NATURAL GAS IGNITION CHEMISTRY Annual Report, Jan. - Dec. 1989
D. R. Crosley, D. M. Golden, and G. P. Smith Jan. 1990 20 p
(Contract GRI-5087-260-1444)
(PB91-127993; SRI-MP-90-022; GRI-90/0209.1) Avail: NTIS HC/MF A03 CSCL 21B

The research is aimed at developing and using laser-induced fluorescence (LIF) of various hydrocarbon species as probes in natural gas combustion research and at developing an understanding of the chemical mechanisms of ignition, gas phase, and catalytically stabilized natural gas combustion. LIF in the B-X and C-X systems of the HCO intermediate were observed for the first time, using photolysis of acetaldehyde in a flow cell as the radical source. Based on this spectroscopic study, HCO was then detected in a flame for the first time using optical detection. LIF was used to measure profiles of HCO, OH, and the temperature in a 6-Torr methane/oxygen flame. A flame model predicts correct ordering of all species but they arise later in the flame than measured. These low-pressure flames form an especially crucial test of the model predictions. RRKM rate theory was applied to the reactions OH and OD + CO. A laser pyrolysis experiment was computationally designed and set up to determine the branching fraction for OH production in the reaction CH3 + O2. GRA

N91-21263# R and D Associates, Los Angeles, CA.
IMPROVED FITS FOR THE VIBRATIONAL AND ROTATIONAL CONSTANTS OF MANY STATES OF NITROGEN AND OXYGEN Technical Report, 1 Aug. - 1 Dec. 1989
Russ R. Laher and Forrest R. Gilmore 1 Dec. 1990 90 p
(Contract DNA001-88-C-0046)
(AD-A229996; RDA-TR-0226129003-001) Avail: NTIS HC/MF A05 CSCL 20/5

All pertinent published measurements of the vibrational intervals and rotational constants for 17 states of nitrogen, the ground state of O2, have been assembled and plotted against v. (These are the states important in modeling the fluorescence produced when air is bombarded by fast electrons.) In about 70 percent of the states considered these tabulated coefficients do not give optimum fits of the basic spectroscopic data, usually because of new data published since 1979. In these cases new improved coefficients have been derived by least-squares fitting. The results are tabulated and plotted. GRA

N91-21264# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
SPRAY COMBUSTION MODELING AND EVALUATION
L. H. Back, J. Bellan, E. Kwack, P. Shakkottai, and K. Harstad Jan. 1991 33 p
(Contract DE-AI01-86CE-90237)
(DE91-007923; JPL-D-8051) Avail: NTIS HC/MF A03

The overall objective of this task is to produce and evaluate a spherically-symmetric, analytical model of multicomponent-fuel spray combustion, including the formation and combustion of cenospheres. It is intended that such a model could ultimately be incorporated into a composite computer program for predicting the performance of industrial furnace and boiler designs fired with arbitrary liquid fuels. The primary objectives for CY 1990 are to: model the evaporation of multicomponent-fuel-sprays; prepare a computer code; prepare a manuscript for publication of this work; initiate multicomponent spray ignition and combustion modeling; and carry out some experiments designed to validate evaporation models developed under this program. DOE

N91-21265# Oak Ridge National Lab., TN.
APPLICATIONS AND CURRENT LIMITATIONS OF MATRIX-ASSISTED LASER DESORPTION FOURIER TRANSFORM MASS SPECTROMETRY FOR BIOMOLECULES
R. L. Hettich and M. V. Buchanan 1991 3 p Presented at the Workshop on Laser Ablation: Mechanisms and Applications, Oak Ridge, 8-10 Apr. 1991
(Contract DE-AC05-84OR-21400)
(DE91-008877; CONF-9104192-1) Avail: NTIS HC/MF A01

The recent advances in matrix-assisted laser desorption mass spectrometry have indicated tremendous potential for the analysis of large biomolecules (MW greater than 100,000 Daltons) such as

peptides and oligonucleotides. To achieve soft ionization for these large molecules, a matrix compound such as nicotinic acid is mixed with a small amount of the biological analyte. This matrix helps absorb the laser radiation and subsequently reduce the fragmentation of the analyte ions. The objective of our research is to develop and refine laser desorption Fourier Transform Mass Spectrometry (FTMS) for the detailed structural characterization of biomolecules at the isomeric level. This presentation will focus on the development and application of matrix-assisted laser desorption FTMS for the examination of normal and modified oligonucleotides. Current research involves investigation and optimization of experimental parameters which will extend the mass range for the FTMS experiments. DOE

N91-21266# Argonne National Lab., IL.
ANALYTICAL CHEMISTRY LABORATORY
Dec. 1990 50 p
(Contract W-31-109-eng-38)
(DE91-008986; ANL/ACL-90/2) Avail: NTIS HC/MF A03

The purpose of this report is to summarize the activities of the Analytical Chemistry Laboratory (ACL) at Argonne National Laboratory (ANL) for Fiscal Year 1990. The ACL has four technical groups involved in the following areas: chemical analysis, instrumental analysis, organic analysis, and environmental analysis. The Chemical Analysis Group uses wet-chemical and instrumental methods for elemental, compositional, and isotopic analyses of solid, liquid, and gaseous samples and provides specialized analytical services. The Instrumental Analysis Group uses nuclear counting techniques in radiochemical analyses over a wide range of sample types from low-level environmental samples to samples of high radioactivity. The Organic Analysis Group uses a number of complementary techniques to separate and to quantitatively and qualitatively analyze complex organic mixtures and compounds at the trace level, including synthetic fuels, toxic substances, fossil-fuel residues and emissions, pollutants, biologically active compounds, pesticides, and drugs. The Environmental Analysis Group performs analyses of inorganic environmental and hazardous waste and coal samples. DOE

N91-21267# Pacific Northwest Lab., Richland, WA.
GRAPHICAL USER INTERFACES IN COMPUTATIONAL CHEMISTRY
R. A. Bair Sep. 1990 51 p Presented at the Workshop on Graphical User Interfaces in Computational Chemistry, Seattle, 5-7 Sep. 1990
(Contract DE-AC06-76RL-01830)
(DE91-009116; PNL-SA-18847; CONF-9009303-1) Avail: NTIS HC/MF A04

The Workshop on Graphical User Interfaces in Computational Chemistry, was intended as an opportunity for a small group of interested computational chemists and computer scientists to: exchange ideas, collectively examine aspects of the interface and the interface development process, explore the possibilities for collaborative efforts, and to consider directions for future development while this field is still in it's infancy. The following topics, which were covered in greater depth in working groups, included: needs for graphical user interfaces in computational chemistry; the chemistry user interface environment; the interface design process in computational chemistry; software design tools for graphical user interfaces; and determining the characteristics of a successful interface. Each working group reported its results to the workshop as a whole for debate and discussion. The analysis, conclusions and recommendations of these working groups are brought together in this report along with some background material. This report presents the mission of the Environmental and Molecular Sciences Laboratory and its Molecular Science Research Center (MSRC), a summary of the workshop conclusions, and the detailed reports from each of the five working groups listed above. DOE

N91-21268# European Space Agency, Paris (France).
ON THE DYNAMICS OF THE COMBUSTION PROCESS OF HYDROGEN-AIR AND HYDROGEN-METHANE-AIR MIXTURES Ph.D. Thesis - Technische Univ.
Helmut Eichert (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Stuttgart, Germany, F.R.) Nov. 1990 149 p Transl. into ENGLISH of Zur Dynamik des Verbrennunnungsablaufs vo Wasserstoff-Luft- und Wasserstoff-Methan-Luft-Gemischen (Stuttgart, Fed. Republic of Germany, DLR), 1989 114p Original language document was announced as N90-18548
(ESA-TT-1198; DLR-FB-89-39; ETN-91-98969) Avail: NTIS HC/MF A07; original German version available from DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 35 DM

The dynamics of the combustion process of hydrogen-air and hydrogen-methane-air mixtures in long tubes, the boundary conditions for deflagration/detonation transition and the associated variations in pressure were investigated experimentally and numerically. Different inhibitors were considered for influencing this combustion process and, in particular, to restrict the range of possible hydrogen-air mixture detonations. The one dimensional random choice method was selected and appropriately developed for the numerical modeling. The numerical calculations are compared with the experimental results. The potential and limitations of this numerical method are indicated. ESA

N91-21269# Lund Inst. of Tech. (Sweden). Working Environment.
SAMPLING AND CHARACTERIZATION OF AEROSOLS Thesis
Ingrid Elisabet Faengmark 1990 56 p Sponsored by Swedish Work Environment Fund and Center for Environmental Research
(LUNDD/TMAT-90/2002; FOA-B-40384-4.5; ISSN-0281-0263; ETN-91-99048) Avail: NTIS HC/MF A04

A flue gas particulate sample was collected from a coal fired power plant by a cooling and dilution probe. The collected particles were subjected to chemical characterization. A personal impinger, designed for the collection of airborne microorganisms, was tested for collection efficiency by two test methods. The most reproducible results were obtained when an optical particle counter was used to count a test aerosol of solid particles. The collection efficiency for the impinger (inlet included) was determined for different flow rates and different distances to the impaction surface. The same test method was used to test the aerosol collection efficiency for two flue sampling trains used for chlorinated dioxins and dibensofurans. ESA

N91-21270* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
CATALYST FOR CARBON MONOXIDE OXIDATION Patent
Billy T. Upchurch, inventor (to NASA), Irvin M. Miller, inventor (to NASA), David R. Brown, inventor (to NASA), Patricia P. Davis, inventor (to NASA), David R. Schryer, inventor (to NASA), Kenneth G. Brown, inventor (to NASA), and John D. VanNorman, inventor (to NASA) (Old Dominion Univ., Norfolk, VA.) 5 Feb. 1991 4 p Filed 30 Nov. 1989 Division of US-Patent-Appl-SN-298150, filed 18 Jan. 1989
(NASA-Case-LAR-14155-2-SB; US-Patent-4,991,181; US-Patent-Appl-SN-443406; US-Patent-Appl-SN-298150; US-Patent-Class-372-59; US-Patent-Class-423-247; US-Patent-Class-502-34; US-Patent-Class-502-324; Int-Patent-Class-H01S-3/22) Avail: US Patent and Trademark Office CSCL 07D

A catalyst for the combination of CO and O2 to form CO2 which includes a platinum group metal, e.g., platinum; a reducible metal oxide having mulitple valence states, e.g., SnO2; and a compound which can bind water to its structure, e.g., silica gel. This catalyst is ideally suited for application to high powered, pulsed, CO2 lasers operating in a sealed or closed cycle condition.
Official Gazette of the U.S. Patent and Trademark Office

N91-21271# Brookhaven National Lab., Upton, NY.
FAST QUASI-EXPLICIT FINITE DIFFERENCE SIMULATION OF ELECTROCHEMICAL RESPONSES INITIATED BY A DISCONTINUOUS PERTURBATION
S. W. Feldberg 1991 2 p Presented at the 179th Meeting of the Electrochemical Society, Washington, 5-10 May 1991
(Contract DE-AC02-76CH-00016)
(DE91-006917; BNL-45634; CONF-910552-6) Avail: NTIS HC/MF A01

Commencing in the early 60s the application of explicit finite difference (EFD) methods to the analysis of electrochemical problems paralleled the development and availability of fast, main-frame, digital computers. The appeal of the EFD method has been its simplicity of principle and of application. EFD algorithms, however, are notoriously inefficient for solving certain types of stiff problems (e.g., problems involving a wide dynamic range of time constants). In this presentation the author discusses the principles and some applications of a fast quasi-explicit finite difference (FQEFD) method in which the computational speed is enhanced, by many orders of magnitude in some cases, without compromising the user friendliness which has popularized the EFD method. The method is designed to treat electrochemical responses to a discontinuous (e.g., chronoamperometric) perturbation and utilizes the DuFort-Frankel algorithm (1) with exponentially expanding space, and (2) exponentially expanding time grids. (A previously published version of the FQEFD method (3,4) was designed to treat electrochemical responses to a continuous (e.g., cyclic voltammetric) perturbation and utilizes the DuFort-Frankel (3) algorithm in conjunction with an exponentially expanding space grid and a uniform time grid. The development of the basic FQEFD equations was presented there). The protocol for introducing the expanding time grid is straightforward and is discussed. DOE

N91-21272# Massachusetts Inst. of Tech., Cambridge.
CONTROL OF CATALYTIC HYDROTREATING SELECTIVITY WITH AMMONIA
C. N. Satterfield and Chung M. Lee 1991 9 p
(Contract DE-FG22-89PC-89775)
(DE91-008405; DOE/PC-89775/3) Avail: NTIS HC/MF A02

Research continues on catalytic hydrotreating control with ammonia. This quarter a detailed study of quinoline and naphthalene was completed. A mixture of quinoline and naphthalene was hydrotreated. The catalyst was a commercial NiMo/Al2O3. Results showed the hydrodenitrogenation of quinoline is moderately inhibited by ammonia. Ammonia has little effect on hydrogen consumption during the hydrogenation of naphthalene. Ammonia also improved selectivity to tetralin. DOE

N91-21273# Lawrence Livermore National Lab., CA.
SIMULATION OF CHEMICAL KINETICS IN COMBUSTION
C. K. Westbrook and W. J. Pitz 1990 9 p Presented at the Conference on Mechanism of Non-Uniform Combustion, Tokyo, Japan, 10-11 Sep. 1990
(Contract W-7405-eng-48)
(DE91-008446; UCRL-JC-105417; CONF-9009347-1) Avail: NTIS HC/MF A02

Current modeling capabilities in the area of hydrocarbon fuel combustion are reviewed. The types of fuels which can be studied, the experimental conditions which can be examined, and the classes of practical problems which can be addressed will be outlined in this paper. We will use the technical problem of automotive engine knock as a case study, to illustrate the capabilities of current kinetic models. DOE

N91-21274# Lawrence Livermore National Lab., CA.
SCANNING TUNNELING MICROSCOPY OF REACTIVE SITES: GASIFICATION OF GRAPHITE BY OXYGEN AND HYDROGEN
M. Balooch, W. J. Siekhaus, and R. J. Tench Jan. 1991 15 p Presented at the Engineering Foundation Conference, Santa Barbara, 1-11 Jan. 1991
(Contract W-7405-eng-48)
(DE91-008569; UCRL-JC-106518; CONF-910186-2) Avail: NTIS HC/MF A03

Scanning tunneling microscopy (STM) is used to study the kinetics of graphite gasification by oxidation and the morphology of platinum catalyzed hydrogen reaction. The graphite sample is heated conventionally for long-term measurement at low to moderate temperatures, or by laser with millisecond exposure times at high temperatures. The oxidation of graphite takes place on step edges, domain boundaries, and on individual dislocation or impurity sites on terraces. The reaction at individual reaction sites on the terraces leads either to removal of disks of graphite two monolayers deep, or to removal of cones of graphite. The reactivity of a particular site is determined (over twelve orders of magnitude) by measuring the edge's recession velocity at the site. The rate of gasification of graphite by ozone is orders of magnitude higher than gasification by oxygen in air at a given temperature. Clusters of platinum deposited on graphite act as catalysts to dissociate molecular hydrogen; thus, they enhance the gasification. Discrete clusters stay with the receding carbon site, resulting in channels on the graphite surface. DOE

N91-21275# Los Alamos National Lab., NM.
HIGH-PERFORMANCE CAPILLARY ELECTROPHORESIS OF HISTONES
L. R. Gurley, J. E. London, and J. G. Valdez 1991 28 p Presented at the HPCE '91: High Performance Capillary Electrophoresis, San Diego, Feb. 1991
(Contract W-7405-eng-36)
(DE91-008585; LA-UR-91-510; CONF-910293-1) Avail: NTIS HC/MF A03

A high performance capillary electrophoresis (HPCE) system has been developed for the fractionation of histones. This system involves electro-injection of the sample and electrophoresis in a 0.1M phosphate buffer at pH 2.5 in a 50 microns x 35 cm coated capillary. Electrophoresis was accomplished in 9 minutes separating a whole histone preparation into its components in the following order of decreasing mobility; more hydrophobic (MHP) H3, H1 (major variant), H1 (minor variant), (LHP) H3, (MHP) H2A (major variant), less hydrophobic component (LHP) H2A, H4, H2B, (MHP) H2A (minor variant). This order of separation is very different from that found in acid-urea polyacrylamide gel electrophoresis and in reversed-phase HPLC; thus, the histone biochemist is given a new dimension for the qualitative analysis of histone samples. DOE

N91-21276# Lawrence Livermore National Lab., CA.
POTENTIOMETRIC TITRATION OF GOLD, PLATINUM, AND SOME OTHER PRECIOUS METALS
W. S. Selig Feb. 1991 15 p Presented at the International Precious Metals Institute Sampling and Analysis Seminar, New Orleans, 10-12 Mar. 1991
(Contract W-7405-eng-48)
(DE91-008989; UCRL-JC-106511; CONF-9103135-1) Avail: NTIS HC/MF A03

Gold, platinum, and several other platinum metals can be determined by titration with cetylpyridinium chloride (CPC). CPC forms a precipitate with AuCl4(-) and PtCl6(exp 2-). Differentiation of AuCl4(-) and PtCl6(exp 2-) with this titrant is not possible; however, their sum can be determined. Titration with tetraphenylarsonium chloride at pH 1 is selective for tetrachloroaurate, which thus can be determined in the presence of hexachloroplatinate. Hexachloroosmate(IV), tetrachloroplatinite(II), tetrachloropalladate(II), hexachloropalladate(IV), and hexachloroiridate(IV) can also be determined potentiometrically vs. CPC. The indicating electrode is prepared by coating a spectroscopic graphite rod with a solution of poly(vinyl chloride) (PVC) and dioctylphthalate (DOP) in tetrahydrofuran (THF). Gold in gold cyanide plating baths and in potassium aurocyanide can be determined by potentiometric titration vs standard silver nitrate, using a silver ion-selective indicating electrode. The monovalent gold need not be converted to the trivalent state with aqua regia, resulting in a considerable saving of time and effort. Free cyanide and aurocyanide can be titrated sequentially by this method. Chloride does not interfere and can, in fact, also be sequentially determined. DOE

N91-21277# Rochester Univ., NY.
PHOTOCHEMISTRY AND CHARGE TRANSFER CHEMISTRY OF THE PLATINUM GROUP ELEMENTS
R. Eisenberg Dec. 1990 7 p
(Contract DE-FG02-90ER-14125)
(DE91-009153; DOE/ER-14125/1) Avail: NTIS HC/MF A02

The research program focuses on the photochemistry and photophysics of dithiolate complexes of the platinum group elements. The specific systems under investigation are square planar complexes of Pt(2) containing one dithiolate chelate and two other ligands to complete the coordination sphere. Several members of the target series of compounds have been synthesized and found to exhibit luminescence in fluid solution. These initial complexes possessed a diimine ligand such as bipyridine (bpy), o-phenanthroline (phen) or an alkyl substituted derivative in addition to the dithiolate chelate. For one of the complexes the dithiolate was maleonitriledi-thiolate (mnt) and for the other complex it was ethyl-2-cyano-3, 3-dithiolatoacrylate (ecda). Both complexes were observed to be highly solvatochromic, and the emission spectra of selected members gave evidence of multiple emitting states. DOE

N91-21278# Oak Ridge National Lab., TN.
RAPID DETERMINATION OF DRUGS AND SEMIVOLATILE ORGANICS BY DIRECT THERMAL DESORPTION ION TRAP MASS SPECTROMETRY
M. B. Wise, R. H. Ilgner, M. V. Buchanan, and M. R. Guerin 1991 5 p Presented at the 2nd International Symposium on Field Screening Methods for Hazardous Wastes and Toxic Chemicals, Las Vegas, 12-14 Feb. 1991
(Contract DE-AC05-84OR-21400)
(DE91-008885; CONF-910278-3) Avail: NTIS HC/MF A01

Direct thermal desorption of analytes into an ion trap mass spectrometer (ITMS) is being investigated as a technique for the rapid screening of a wide variety of samples for target semivolatile organic compounds. This includes the direct detection of drugs in physiological fluids, semivolatile organic pollutants in water and waste samples, and air pollutants collected on sorbent cartridges. In order to minimize the analysis time, chromatographic separation is not performed on the sample prior to introduction into the ITMS. Instead, selective chemical ionization and tandem mass spectrometry (MS/MS) are used achieve the specificity required for the target analytes. Detection limits are typically 10-50 ppb using a 1 uL aliquot of a liquid sample without preconcentration. Sample turn-around time is 2 to 5 minutes and 3 to 5 target analytes can be quantitatively determined simultaneously. DOE

N91-21279# Ames Lab., IA.
ENHANCED SELECTIVITY AND DETECTABILITY IN ABSORPTION AND FLUORESCENCE METHODS BASED ON POLARIZATION MODULATION Ph.D. Thesis
P. L. Christensen Jan. 1991 131 p
(Contract W-7405-eng-82)
(DE91-008926; IS-T-1449) Avail: NTIS HC/MF A07

Polarization properties of light can be exploited to develop more selective spectroscopic methods of chemical analysis. Modulation of polarization coupled with lock-in detection provides a powerful detection scheme with improved detectabilities. This dissertation demonstrates the importance of optical design in systems utilizing polarization modulation. Optimization of modulation frequency and efficiency and simplification of optical design led to a 10-fold improvement in the detectability for sodium atoms by laser polarization spectroscopy. The limit of detection for sodium atoms by this method is 2 ng/l. The increased S/N at 150 kHz allowed operation in the dispersion mode and subsequently provided linear calibration curves. The first studies of fluorescence-detected circular dichroism (FDCD) for on-column detection in capillary electrophoresis (CE) are presented. Detection by direct fluorescence (FL) is carried out simultaneously and provides a convenient means of evaluating the FDCD performance. Modulation efficiency and balance and preservation desired polarization are discussed in detail and are shown to have great influence on the selectivity attainable by FDCD. Among techniques that sense optical activity, FDCD provides superior detectability on an absolute scale because it is suitable for picoliter detection volumes. Optical activity signals were observed for riboflavin (LOD = 0.2 fmol) and for less than 50 fmol of some fluorescein isothiocyanate-amino acid derivatives (FTC-amino acids) by FDCD/FL-CE. The major chapters have been indexed separately for inclusion on the data base. DOE

N91-21280# Sandia National Labs., Albuquerque, NM.
EFFECT OF EQUATIONS OF STATE ON TRANSIENT BURNING ANALYSIS OF PYROTECHNIC MATERIALS IN A CLOSED SYSTEM
A. Razani, M. Shahinpoor (New Mexico Univ., Albuquerque.), and S. L. Hingorani 1990 12 p Presented at the 32nd Annual Meeting on Pyrotechnics and Explosives Applications Section (ADPA), Albuquerque, 2-4 Oct. 1990
(Contract DE-AC04-76DP-00789)
(DE91-009167; SAND-90-1851C; CONF-9010254-2) Avail: NTIS HC/MF A03

The effect of equations of state on transient burning of pyrotechnic materials burning in a closed system is discussed. The effect of condensed species and appropriate equations of state parameters as generated from chemical equilibrium codes such as the BLAKE and the TIGER are presented. It is shown that defining a co-volume for use in transient burning analysis in the presence of condensed species requires careful considerations. A variable co-volume is defined for use in simplified transient burning analysis. Furthermore, its effect on pressure-time history of pyrotechnic materials burning in a closed system is presented. A pressure dependent co-volume for the analysis of a particular pyrotechnic material greatly simplifies its transient burning analysis under zero-volume firing conditions. The formulation of transient burning in a closed system is developed using the NBS equation of state. DOE

N91-21281# Brown Univ., Providence, RI.
MODIFIED CHEMICAL VAPOR DEPOSITION OF GRADIENT INDEX LENSES Final Report, 1 Oct. 1987 - 30 Sep. 1990
T. F. Morse Nov. 1990 7 p
(Contract DAAL03-87-K-0148)
(AD-A230989; ARO-24566.8-MS) Avail: NTIS HC/MF A02 CSCL 11/3

The main research result to come from this research is the development of a new technique for the fabrication of multicomponent amorphous solids. In this method, it is possible to vary the composition of the solid during processing, thus permitting the structuring of the index of refraction in a controlled manner. It is possible to include low volatility dopants into a convective stream, and to do this in the absence of chlorine. This allows one to incorporate, in an oxide glass, many elements whose chloride is either volatile or more favored than the oxide. GRA

N91-21282# Boston Univ., MA. Dept. of Chemistry.
PHOTOASSISTED REACTION OF H2 WITH CO2 OVER SOLID CATALYSTS Final Report, 1 Jul. 1984 - 31 Dec. 1988
Norman N. Lichtin Jan. 1991 3 p
(Contract N00014-84-K-0557)
(AD-A231045) Avail: NTIS HC/MF A01 CSCL 07/4

Photo-promoted hydrogenation of CO2 at 1 atm total pressure over a number of catalysts was investigated. CO was the principal product of both the dark and photo-promoted reactions in the presence and absence of water vapor. The first batch of a Co-Mo-Al-Oxide preparation was the most active photocatalyst investigated, giving 0.35 molec. of CO per incident photon of white light and, in the presence of water vapor, a yield of CO equal to 10 times its concentration at thermal equilibrium. Studies of this system included the action spectrum for formation of CO and the dependence of rate on the CO2/H2 ratio, on temperature and on intensity of white light. The catalyst was a heterogeneous mixture of several phases. Subsequent batches of Co-Mo-Al-Oxide, prepared according to the original protocol, differed from the first batch in composition and were less active photocatalysts. Similar

studies were carried out using pristine and platinized DeGussa P-25 TiO2 as catalyst. GRA

N91-21283# North Carolina Univ., Chapel Hill. Dept. of Chemistry.
EX-SITU AND IN-SITU ELLIPSOMETRIC STUDIES OF THE THERMAL OXIDE ON InP Interim Technical Report
X. Liu, J. W. Andrews, and Eugene A. Irene 6 Dec. 1990 37 p
(Contract N00014-89-J-1178)
(AD-A231095; TR-31) Avail: NTIS HC/MF A03 CSCL 07/2

The thermally grown InP oxide as etched by an aqueous dilute HF solution has been studied by ellipsometric techniques. The ex-situ measurement reveals a two-layer structure for the oxide grown at 440 C. The reflective indices for both oxide layers have been determined using a two-layer optical model. The etching process has also been monitored ellipsometrically in the real etching environment, in-situ. A fused silica cell, which enables the windows to be aligned properly, has been specifically designed for the in-situ solution measurement. A liquid layer at the solution-oxide interface has been identified, and the layer is shown to contain P and In species resulting in a reasonable qualitative description of the liquid layer. During the etching of the oxide the liquid layer shrinks at a linear rate, and after removal of the outer oxide layer the liquid layer forms a dense electric double layer. GRA

N91-21284# New Hampshire Univ., Durham. Dept. of Physics.
A STUDY OF HELIUM. ARGON: ETHANE GAS MIXTURES USED IN DRIFT CHAMBERS FOR LARGE ACCEPTANCE SPECTROMETERS IN HIGH MAGNETIC FIELDS M.S. Thesis
Jyuji D. Hewitt 7 Dec. 1990 83 p
(AD-A231209) Avail: NTIS HC/MF A05 CSCL 18/4

For today's large acceptance spectrometers, precise knowledge of electrons in gases and magnetic fields is required for particle track reconstruction. Measurements under a variety of conditions must be performed in order to accurately model these processes with software simulations such as GARFIELD. At Brookhaven National Laboratory, a prototype drift chamber, constructed at the Continuous Electron Beam Accelerator Facility (CEBAF), incorporating a hex-cell wire pattern, was filled with helium:argon:ethane and tested in a high magnetic field. Additionally, this without the magnetic field. The results of these tests are compared and indicate little change in the drift velocity of this gas mixture in and out of a high magnetic field. GRA

N91-21285# Michigan State Univ., East Lansing.
FIRST PRINCIPLES THEORY OF THE INTERACTION OF HYDROGEN WITH SURFACES AND BULK OF TRANSITION METALS Annual Report, 15 Dec. 1989 - 14 Dec. 1990
David Tomanek Jan. 1991 17 p
(Contract N00014-90-J-1376)
(AD-A231248; ORD-48508) Avail: NTIS HC/MF A03 CSCL 07/2

This study compares hydrogen-induced changes of electronic and structural properties at metal surfaces to changes which occur when hydrogen atoms are absorbed in the bulk. Modifications of the metal binding near hydrogen atoms are investigated using first principles theoretical methods. Our results indicate the possibility of understanding the origins of hydrogen-induced surface reconstruction and of hydrogen-induced embrittlement of bulk metals on the same grounds. GRA

26 METALLIC MATERIALS

Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

N91-21286*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
ATOMIC OXYGEN DEGRADATION OF INTELSAT 4-TYPE SOLAR ARRAY INTERCONNECTS: LABORATORY INVESTIGATIONS
S. L. Koontz, J. B. Cross, M. A. Hoffbauer, and T. D. Kirkendahl (Communications Satellite Corp., Clarksburg, MD.) Mar. 1991 25 p
(NASA-TM-102175; S-625; NAS 1.15:102175) Avail: NTIS HC/MF A03 CSCL 11F

A Hughes 506 type communication satellite belonging to the Intelsat organization was marooned in low Earth orbit on March 14, 1990, following failure of the Titan third stage to separate properly. The satellite, Intelsat VI, was designed for service in geosynchronous orbit and contains several material configurations which are susceptible to attack by atomic oxygen. Analysis showed the silver foil interconnects in the satellite photovoltaic array to be the key materials issue because the silver is exposed directly to the atomic oxygen ram flux. The results are reported of atomic oxygen degradation testing of Intelsat VI type silver foil interconnects both as virgin material and in a configured solar cell element. Test results indicate that more than 80 pct. of the original thickness of silver in the Intelsat VI solar array interconnects should remain after completion of the proposed Space Shuttle rescue and/or reboost mission. Author

N91-21287*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
AN EVALUATION OF GTAW-P VERSUS GTA WELDING OF ALLOY 718
W. R. Garnwell, C. Kurgan, and T. W. Malone Mar. 1991 21 p
(NASA-TM-103529; NAS 1.15:103529) Avail: NTIS HC/MF A03 CSCL 11F

Mechanical properties were evaluated to determine statistically whether the pulsed current gas tungsten arc welding (GTAW-P) process produces welds in alloy 718 with room temperature structural performance equivalent to current Space Shuttle Main Engine (SSME) welds manufactured by the constant current GTAW-P process. Evaluations were conducted on two base metal lots, two filler metal lots, two heat input levels, and two welding processes. The material form was 0.125-inch (3.175-mm) alloy 718 sheet. Prior to welding, sheets were treated to either the ST or STA-1 condition. After welding, panels were left as welded or heat treated to the STA-1 condition, and weld beads were left intact or machined flush. Statistical analyses were performed on yield strength, ultimate tensile strength (UTS), and high cycle fatigue (HCF) properties for all the post welded material conditions. Analyses of variance were performed on the data to determine if there were any significant effects on UTS or HCF life due to variations in base metal, filler metal, heat input level, or welding process. Statistical analyses showed that the GTAW-P process does produce welds with room temperature structural performance equivalent to current SSME welds manufactured by the GTAW process, regardless of prior material condition or post welding condition. Author

N91-21288# Los Alamos National Lab., NM.
DEFORMATION SUBSTRUCTURES INDUCED BY HIGH-RATE DEFORMATION
G. T. Gray, III 1991 17 p Presented at the Annual Meeting and Exhibition of the Minerals, Metals and Materials Society, New Orleans, 17-21 Feb. 1991
(Contract W-7405-eng-36)
(DE91-008595; LA-UR-91-610; CONF-910202-6) Avail: NTIS HC/MF A03

The influence of increasing strain on the deformation substructures in metals and alloys which deform predominately by slip is very similar to that seen following quasi-static deformation at increasingly lower temperatures or due to a decrease in stacking fault energy (gamma sub sf). For constant strain, deformation at higher rates: (1) produces more uniform dislocation distributions for the same amount of strain, (2) hinders dislocation cell formation, (3) decreases the cell size, and (4) increases misorientaion with more dislocations trapped within the cell interiors. The suppression of thermally activated dislocation processes in this regime, added to high temperature and strain rate sensitivity of the yield stress exhibited by many materials, can lead to stresses high enough to nucleate and grow deformation twins even in high stacking fault

energy FCC metals such as copper and Al-4.8 wt pct. Mg. In addition, substructures formed under high rate conditions differ from those formed under low rate conditions due to the suppression of dynamic recovery process. Finally, in high rate deformation such as shock loading, the subsonic restriction on dislocation motion leads to higher dislocation and point defect generation rates, resulting in enhanced hardening when compared to materials deformed to equivalent strains at quasi-static rates. Examples of the deformation substructure evolution observed in aluminum, copper, Ni3Al, iron, Ti-6Al-4V, and TiAl at high and shock loading strain rates are presented and compared to that seen following low rate deformation paths. DOE

N91-21289# Oak Ridge National Lab., TN.
MEASUREMENT OF RESIDUAL STRESSES BY X RAY DIFFRACTION NEAR SIMULATED HEAT AFFECTED ZONES IN AUSTENITIC STAINLESS STEELS
V. S. Iyer, R. W. Hendricks (Virginia Polytechnic Inst. and State Univ., Blacksburg.), and S. A. David 1990 9 p Presented at the 39th Annual Denver X Ray Conference, Steamboat Springs, 30 Jul. - 3 Aug. 1990
(Contract DE-AC05-84OR-21400)
(DE91-008874; CONF-9007149-6) Avail: NTIS HC/MF A02

Simulated heat affected zones (HAZs) were made in austenitic stainless steel specimens using a Gleeble. The samples were heated to temperatures as high as 1100 C by computer controlled resistance heating. By controlling the heating rate, maximum temperature, and cooling rate, a wide range of residual stresses were introduced in the specimens. Stress measurements were made using X ray diffraction. It was found that significant stress gradients were produced in the simulated HAZs, and that all stresses were compressive in nature, both in the longitudinal and transverse directions. These results are not representative of the residual stresses determined in the HAZs of real welds, thus calling into question some aspects of the role of the Gleeble in such simulations. DOE

N91-21290# California Univ., Berkeley. Lawrence Berkeley Lab.
MICROMECHANISMS OF FRICTION IN ELECTROGALVANIZED SHEET STEEL WITH EMPHASIS ON THE ROLE OF TEXTURE Ph.D. Thesis
S. J. Shaffer Dec. 1990 108 p
(Contract DE-AC03-76SF-00098)
(DE91-009113; LBL-29960) Avail: NTIS HC/MF A06

The role of texture (preferred crystallographic orientation) of the zinc coating in friction of electrogalvanized steels is investigated. Samples of sharp (1) basal (fine grained and course grained), (2) low angle pyramid, (3) high angle pyramid, and, achieved through the addition of cadmium to the electrolyte, (4) prism textures, which were produced via laboratory electrodeposition, were friction tested using both a drawbead simulator (DBS) and a one-sided straight stripdraw test. It was found that the initial texture of the samples did not influence friction through the zinc's anisotropic response to loading. However the fine grained basal samples did exhibit unusually high friction, which was attributed to a rapid increase in contact area fraction due to easy shearing of the individual zinc crystallites. In an opposite manner, the prism textured samples exhibited exceptionally low friction as a result of low contact area fraction, which was attributed to a combination of higher hardness and a rougher topography. It is concluded that those factors within the coating which dictate contact area fraction control friction. The two most prominent are surface roughness and hardness. It was found through pole figure measurements that large changes in the texture of the zinc, restricted to a depth of about 1 micron, take place as a result of friction testing. Progression toward a common texture is the result of plastic deformation, with strong evidence of recrystallization. Calculations of resolved shear stresses for slip on the basal system corroborated this through predicted difficulty in deformation for orientations whose basal poles lie along a trace perpendicular to the macroscopic shearing direction. Finally, techniques for rapid in-sheet-plane texture measurement and for deconvolution of textures as a function of depth and contact area fraction are proposed. DOE

N91-21291# California Univ., Berkeley. Lawrence Berkeley Lab.
BROAD-BEAM, HIGH CURRENT, METAL ION IMPLANTATION FACILITY
I. G. Brown, M. R. Dickinson, J. E. Galvin, X. Godechot, and R. A. MacGill Jul. 1990 13 p Presented at the 8th International Conference on Ion Implantation Technology, Guildford, England, 30Jul. - 3 Aug. 1990
(Contract DE-AC03-76SF-00098)
(DE91-009329; LBL-28685; CONF-900722-1) Avail: NTIS HC/MF A03

We have developed a high current metal ion implantation facility with which high current beams of virtually all the solid metals of the Periodic Table can be produced. The facility makes use of a metal vapor vacuum arc ion source which is operated in a pulsed mode, with pulse width 0.25 ms and repetition rate up to 100 pps. Beam extraction voltage is up to 100 kV, corresponding to an ion energy of up to several hundred keV because of the ion charge state multiplicity; beam current is up to several Amperes peak and around 10 mA time averaged delivered onto target. Implantation is done in a broad-beam mode, with a direct line-of-sight from ion source to target. Here we describe the facility and some of the implants that have been carried out using it, including the 'seeding' of silicon wafers prior to CVD with titanium, palladium or tungsten, the formation of buried iridium silicide layers, and actinide (uranium and thorium) doping of III-V compounds. DOE

N91-21292# Sandia National Labs., Albuquerque, NM.
CO2 INDUCED INHIBITION OF THE LOCALIZED CORROSION OF ALUMINUM, Al-0.5 PERCENT Cu, AND Al-2 PERCENT Cu IN DILUTE HF SOLUTION
J. R. Scully (Virginia Univ., Charlottesville.) and D. E. Peebles 1991 4 p Presented at the 179th Meeting of the Electrochemical Society, Washington, 5-10 May 1991
(Contract DE-AC04-76DP-00789)
(DE91-005312; SAND-90-3143C; CONF-910552-1) Avail: NTIS HC/MF A01

This study presents work on corrosion of aluminum, Al-.5 percent Cu, and Al-2 percent Cu. Electrochemical tests were performed in dilute HF solutions both with and without CO2 sparging. It is suggested that CO2 or its reaction products interact with the passive film so that exposure of Cu in the oxide-solution interface is minimized. CO2 is investigated as a corrosion inhibitor. DOE

N91-21293# Brookhaven National Lab., Upton, NY.
XANES (X RAY ABSORPTION NEAR EDGE STRUCTURE) INVESTIGATION OF CERIUM AS AN INHIBITOR FOR Al ALLOYS
A. J. Davenport, H. S. Isaacs, and M. W. Kendig 1991 3 p Presented at the 179th Meeting of the Electrochemical Society, Washington, 5-10 May 1991
(Contract DE-AC02-76CH-00016)
(DE91-005542; BNL-45484; CONF-910552-2) Avail: NTIS HC/MF A01

Cerium ions are under investigation as possible replacements for toxic chromates. The use of cerium ions as corrosion inhibitors for aluminum alloys is investigated using XANES (x ray absorption near edge structure). On immersion in a dilute solution of cerium ions, cerium is incorporated into the oxide films on aluminum alloys in either the 3- or 4-valent state depending upon the alloy and on the surface preparation. DOE

N91-21294# Brookhaven National Lab., Upton, NY.
A STUDY OF THE INHIBITION OF PITTING OF ALUMINUM BY CHROMATE
J. Hawkins, G. E. Thompson, G. C. Wood, and H. S. Isaacs 1991 3 p Presented at the 179th Meeting of the Electrochemical

Society, Washington, 5-10 May 1991
(Contract DE-AC02-76CH-00016)
(DE91-006915; BNL-45594; CONF-910552-4) Avail: NTIS HC/MF A01

The location of chromate activity during the pitting corrosion of aluminum was studied. Scanning vibrating probe technique monitored the current densities above cathodic and anodic sites and SIMS was used to determine the location of chromium reduction products. Products deposited preferentially on cathodes but chromates dramatically inhibited the anodic pitting processes. DOE

N91-21295# Brookhaven National Lab., Upton, NY.
IN-SITU X RAY MEASUREMENTS OF PIT SOLUTIONS DURING LOCALIZED CORROSION
J. H. Cho, A. J. Davenport, and H. S. Isaacs 1991 2 p Presented at the 179th Meeting of the Electrochemical Society, Washington, 5-10 May 1991
(Contract DE-AC02-76CH-00016)
(DE91-006916; BNL-45593; CONF-910552-5) Avail: NTIS HC/MF A01

In this work, in-situ x ray absorption spectroscopy (XAS) measurements of the ion concentrations within an artificial pit are presented to study the ionic species present and mass transport phenomena during localized corrosion taking place on metal surfaces. The x ray absorption by an element in a sample is markedly greater at an energy just above than just below one of its absorption edges and the energy of this edge is characteristic of the absorbing element. A pair of measurements above and below the edge serves to determine both the presence and the amount of the element sought. DOE

N91-21296# Brookhaven National Lab., Upton, NY.
THE USE OF A SCANNING ELECTROCHEMICL IMPEDANCE SPECTROSCOPY TECHNIQUE TO INVESTIGATE LOCALIZED CORROSION
R. S. Lillard, P. J. Moran (Naval Academy, Annapolis, MD.), and H. S. Isaacs 1991 2 p Presented at the 179th Meeting of the Electrochemical Society, Washington, 5-10 May 1991
(Contract DE-AC02-76CH-00016)
(DE91-006918; BNL-45592; CONF-910552-3) Avail: NTIS HC/MF A01

Recently, the authors have proposed a method for generating local electrochemical impedance maps of electrodes. In this technique, impedance maps at each frequency of interest, are generated by measuring the ratio of ac solution current density, very near the electrode, to the applied potential is measured as a function of position. A review of this method, the results from two model systems, which demonstrate that this technique may be used to generate quantitative data, and its use to investigate aluminum alloys will be presented. DOE

N91-21297# California Univ., Berkeley. Lawrence Berkeley Lab.
LEVELLING OF MICROPROFILES IN ELECTRODEPOSITION Ph.D. Thesis
K. G. Jordan Dec. 1990 261 p
(Contract DE-AC03-76SF-00098)
(DE91-009083; LBL-29924) Avail: NTIS HC/MF A12

Current distribution phenomena are addressed in the smoothing of advancing and receding microprofiles during electrodeposition in the following areas: levelling in the presence of inhibitors, levelling in the presence of corrosive agents, and levelling caused by periodic current reversal. These phenomena are relevant to many commercial electrodeposition processes. Theoretical analysis of moving boundaries in electrodeposition is addressed, focusing on the levelling of microscopic surface contours. The literature relevant to the solution of current distribution problems is reviewed. Convection of inhibitors to the depth of trenches is evaluated using the finite element method, and characterized as a function of Reynolds number, notch angle, and depth. Secondary flows are shown to noticeably enhance transport into microscopic trenches only at high Peclet numbers, i.e., at very high flow velocities. The boundary element method (BEM) is used to analyze levelling caused by inhibitors consumed at the transport limiting rate during electrodeposition. It is predicted that (1) better levelling performance can be obtained if the microscopic surface waviness is oriented perpendicular to the convective flow, and (2) for surface roughness oriented parallel to the flow, there is an optimum boundary layer thickness, or flux of additive, which results in superior levelling performance. Profilometry and photomicrography is applied to obtain the current distribution, current efficiency and levelling performance on novel microprofiled electrodes for two orientations with respect to the fluid flow during nickel electrodeposition in the presence of coumarin. Slightly better levelling occurs in flows transverse to grooves, and the deposit thickness increases in the flow direction. It is concluded that coumarin acts by simultaneously lowering the current efficiency, and blocking metal deposition. DOE

N91-21298# Texas Univ., Austin. Center for Materials Science and Engineering.
CONTROLLING FUNDAMENTALS IN HIGH-ENERGY HIGH-RATE PULSED POWER MATERIALS PROCESSING OF POWDERED TUNGSTEN, TITANIUM ALUMINIDES, AND COPPER-GRAPHITE COMPOSITES Final Technical Report, 1 Jun. 1987 - 31 Aug. 1990
C. Persad, Harris L. Marcus, D. L. Bourell, Z. Eliezer, and William F. Weldon Oct. 1990 325 p
(Contract DAAL03-87-K-0073)
(AD-A230900; UTCMSE-90-02; ARO-25143.19-MS-A) Avail: NTIS HC/MF A14 CSCL 11/6

This study was conducted to determine the controlling fundamentals in the high energy high-rate (1 MJ in 1s) processing of metal powders. This processing utilizes a large electrical current pulse to heat a pressurized powder mass. The current pulse was provided by a homopolar generator. Simple short cylindrical shapes were consolidated so as to minimize tooling costs. Powders were subjected to current densities of 5 to 25 kA/sq cm under applied pressures ranging from 70 to 500 MPa. Disks with diameters of 25 to 70 mm, and thicknesses of 1 to 10 mm were consolidated. Densities of 75 to 99 pct. of theoretical values were obtained in powder consolidates of tungsten, titanium aluminides, copper-graphite, and other metal-ceramic composites. Extensive microstructural characterization was performed to follow the changes occurring in the shape and microstructure of the various powder consolidates of tungsten, titanium aluminides, copper-graphite, and other metal-ceramic composites. Extensive consolidation. GRA

N91-21299# Wright Research Development Center, Wright-Patterson AFB, OH.
THE MECHANICAL PROPERTY DATA BASE FROM AN AIR FORCE/INDUSTRY COOPERATIVE TEST PROGRAM ON ADVANCED ALUMINUM ALLOYS (8090 EXTRUSION) Interim Report, Feb. 1986 - Jan. 1990
Mary A. Phillips and Steven R. Thompson Nov. 1990 80 p
(AD-A230903; WRDC-TR-90-4113) Avail: NTIS HC/MF A05 CSCL 11/6

Development of mechanical property data base on Alcan aluminum-lithium structural alloys is detailed. Aluminum lithium alloy tested was 8090-T651 Extrusions. Basic mechanical property data consist of tension, compression, bearing, shear, and fracture toughness. Fatigue data were developed for both smooth and notched specimens. Constant amplitude fatigue crack growth rate data and spectrum test data were generated. Corrosion characteristics were also obtained. All other data developed by the participants are documented. GRA

N91-21300# Army Lab. Command, Watertown, MA. Material Technology Lab.
FORMATION OF CONTROLLED ADIABATIC SHEAR BANDS IN AISI 4340 HIGH STRENGTH STEEL Final Report
John H. Beatty, Lothar W. Meyer, Marc A. Meyers, and Sia Nemat-Nasser Nov. 1990 21 p

(AD-A230999; MTL-TR-90-54) Avail: NTIS HC/MF A03 CSCL 11/6

Adiabatic shear banding is one of the predominant failure modes of ultrahigh strength (UHS) steels under high rates of deformation. Though these bands have been previously studied, the specific factors governing when, how, or if a certain material fails by shear band localization are still relatively unknown. This article examines these questions in terms of the microstructure using a controlled shear strain. Four microstructures of equal hardness (Rc52) with different carbide distributions were produced in a VAR 4340 steel by varying the normalizing temperature (one hour at 845 C, 925 C, 1010 C, or 1090 C). A short duration reaustenitizing treatment was subsequently used to produce similar prior austenite grain sizes; this was followed by a 200 C temper. The controlled shear strain was introduced by the use of a hat-shaped specimen loaded in a split Hopkinson bar rig, producing a shear zone at local strain rates up to 5 x 0.00005. The use of mechanical stops to arrest the deformation process allowed the development of the shear bands to be studied under controlled stress conditions. Transmission electron microscopy (TEM) studies revealed a microcrystalline structure within the shear band with a crystalline size of 8nm to 20nm. A gradual change from the microcrystalline structure within the band to lath martensite was observed. Tensile unloading cracks were observed in the sheared regions. A normalizing temperature of 925 C produced the microstructure with the greatest resistance to unstable shearing. GRA

N91-21301# University of Southern California, Los Angeles. Dept. of Materials Science and Engineering.
ENVIRONMENTALLY-INDUCED PASSIVITY OF ALUMINUM ALLOYS AND ALUMINUM METAL MATRIX COMPOSITES Final Report, 1 Oct. 1987 - 30 Sep. 1990
Florian Mansfeld Dec. 1990 44 p
(Contract N00014-88-K-0034)
(AD-A231350; Rept-53-4511-3393) Avail: NTIS HC/MF A03 CSCL 11/6

This final report presents a summary of the work performed under Contract No. N00014-88-K-0034. One of the goals of the research carried out was to develop corrosion protection methods for Al-based materials which can replace the presently used chromate conversion coatings with modified surface layers of equal or even better resistance to localized corrosion. The past work first evaluated the use of rare earth metal chlorides (REMC) for the passivation of Al alloys and Al/SiC by a simple immersion treatment. Very corrosion resistant surfaces have been obtained in this manner which did not show any localized corrosion during exposure to aerated NaCl for periods up to 60 days. In an attempt to shorten the passivation time, a passivation treatment in solutions of CeCl3, and Ce(NO3)3 has been developed. Very corrosion resistant surfaces have been produced in a process in which immersion in CeCl3 and Ce(NO3)3 was followed by an electrochemical treatment in Na2MoO4. GRA

27 NONMETALLIC MATERIALS

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials.

For composite materials see *24 Composite Materials*.

N91-21302*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
MECHANICAL STRENGTH AND THERMOPHYSICAL PROPERTIES OF PM212: A HIGH TEMPERATURE SELF-LUBRICATING POWDER METALLURGY COMPOSITE Final Report
Phillip M. Edwards (Case Western Reserve Univ., Cleveland, OH.), Harold E. Sliney, Christopher DellaCorte, J. Daniel Whittenberger, and Robert R. Martineau Dec. 1990 30 p
(Contract DE-AI01-85CE-50162)
(NASA-TM-103694; E-5913; NAS 1.15:103694; DOE/NASA/50162-5) Avail: NTIS HC/MF A03 CSCL 11C

A powder metallurgy composite, PM212, composed of metal bonded chromium carbide and solid lubricants is shown to be self-lubricating to a maximum application temperature of 900 C. The high temperature compressive strength, tensile strength, thermal expansion and thermal conductivity data needed to design PM212 sliding contact bearings and seals are reported for sintered and isostatically pressed (HIPed) versions of PM212. Other properties presented are room temperature density, hardness, and elastic modulus. In general, both versions appear to have adequate strength to be considered as sliding contact bearing materials, but the HIPed version, which is fully dense, is much stronger than the sintered version which contains about 20 percent pore volume. The sintered material is less costly to make, but the HIPed version is better where high compressive strength is important. Author

N91-21303# Sandia National Labs., Albuquerque, NM.
UV CURED EPOXY RESIN COATINGS
K. B. Wischmann 1991 5 p Presented at the Environmentally Conscious Manufacturing/Technology Applications Workshop, Albuquerque, 20 Feb. 1991
(Contract DE-AC04-76DP-00789)
(DE91-008180; SAND-91-0292C; CONF-910279-7) Avail: NTIS HC/MF A01

This report discusses the cycloaliphatic epoxide that is UV cured to create protective coatings. Mechanical and electrical properties are briefly discussed. DOE

N91-21304# Oak Ridge National Lab., TN.
THE NUCLEATION AND GROWTH OF POLYCRYSTALLINE SILICON CARBIDE
B. W. Sheldon and T. M. Besmann 1990 6 p Presented at the Fall Meeting of the Materials Research Society, Boston, 24 Nov. - 1 Dec. 1990
(Contract DE-AC05-84OR-21400)
(DE91-008887; CONF-901105-104) Avail: NTIS HC/MF A02

Silicon carbide was deposited from methyltrichlorosilane onto polished polycrystalline SiC substrates at reduced pressure, and the resultant surface morphology was characterized by analyzing the angular spectrum of scattered light which was generated with a He-Ne laser. Light-scattering analyses incorporating specific nucleation and growth models were developed. With these methods, it was possible to analyze the angular scattering spectra and directly measure the nucleation and growth rates. These results were verified by using image analysis to quantify the number and size distribution of surface features that were observed with scanning electron microscopy. The nucleation and growth rates that were obtained by fitting the models to the image-analysis results were in good agreement with the rates obtained from the light-scattering. DOE

N91-21305# Sandia National Labs., Albuquerque, NM.
HIGH TEMPERATURE DEFORMATION OF SILICON
D. G. Ast, G. C. Perreault, and S. L. Hyland (Cornell Univ., Ithaca, NY.) Jan. 1991 155 p
(Contract DE-AC04-76DP-00789)
(DE91-009102; SAND-90-7035) Avail: NTIS HC/MF A08

This work is concerned with characterizing, observing, and exploring the origins of a silicon crystalline defect's electrical properties. These goals are accomplished by unique applications of the electron-beam-induced current (EBIC) technique. Bulk silicon solar cell properties are correlated with EBIC at low accelerating voltage (LAV-EBIC) and high accelerating voltage (HAV-EBIC). HAV-EBIC currents were related linearly to the short-circuit current density, conversion efficiency, and dislocation density, but LAV-EBIC currents were found to be independent of the same properties. The difference in probing depth was used to explain the discrepancy. EBIC and transmission electron microscopy (TEM) were combined into one scanning transmission electron microscope (STEM) to unambiguously correlate electrical activity with defect structure. This technique is successfully applied to defects in polycrystalline silicon, but the complexity and variety of general

silicon defects made this approach unsuitable for uncovering the origins of a defect's electrical activity. These origins were investigated by welding together two float-zone silicon wafers to form twist boundaries. These boundaries are composed of a square array of screw dislocations of sufficient number and purity to separate impurity effects from the intrinsic electrical activity. Applying the Kittler and Seifert model, the silicon screw dislocations were estimated to have between 0.3 and 0.5 recombination sites per Burgers vector. It was subsequently concluded that kinks and jogs were responsible for screw dislocation electrical recombination. DOE

N91-21306*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
SYNTHESIS OF IMIDE/ARYLENE ETHER COPOLYMERS FOR ADHESIVES AND COMPOSITE MATRICES
B. J. Jensen, P. M. Hergenrother, and R. G. Bass (Virginia Commonwealth Univ., Richmond.) Mar. 1991 29 p
(NASA-TM-104067; NAS 1.15:104067) Avail: NTIS HC/MF A03 CSCL 11C

A series of imide/arylene ether copolymers were prepared from the reaction of an amorphous arylene ether oligomer and a semi-crystalline imide oligomer. These copolymers were thermally characterized and mechanical properties were measured. One block copolymer was endcapped and the molecular weight was controlled to provide a material that displayed good compression moldability and attractive adhesion and composite properties. Author

N91-21307*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH. Propulsion Div.
HYDROCARBON-FUEL/COMBUSTION-CHAMBER-LINER MATERIALS COMPATIBILITY Final Report, 31 Oct. 1989 - 31 Mar. 1991
G. David Homer Apr. 1991 116 p
(Contract NAS3-25070)
(NASA-CR-187104; NAS 1.26:187104; KBQ-FR-2) Avail: NTIS HC/MF A06 CSCL 11C

The results of dynamic tests using methane and NASA-Z copper test specimen under conditions that simulate those expected in the cooling channels of a regeneratively cooled LOX/hydrocarbon booster engine operating at chamber pressures up to 3000 psi are presented. Methane with less than 0.5 ppm sulfur contamination has little or no effect on cooling channel performance. At higher sulfur concentrations, severe corrosion of the NASA-Z copper alloy occurs and the cuprous sulfide Cu2S, thus formed impedes mass flow rate and heat transfer efficiency. Therefore, it is recommended that the methane specification for this end use set the allowable sulfur content at 0.5 ppm (max). Bulk high purity liquid methane that meets this low sulfur requirement is currently available from only one producer. Pricing, availability, and quality assurance are discussed in detail. Additionally, it was found that dilute sodium cyanide solutions effectively refurbish sulfur corroded cooling channels in only 2 to 5 minutes by completely dissolving all the Cu2S. Sulfur corroded/sodium cyanide refurbished channels are highly roughened and the increased surface roughness leads to significant improvements in heat transfer efficiency with an attendant loss in mass flow rate. Both the sulfur corrosion and refurbishment effects are discussed in detail. Author

N91-21308*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
IMIDE/ARYLENE ETHER BLOCK COPOLYMERS
B. J. Jensen, P. M. Hergenrother, and R. G. Bass (Virginia Commonwealth Univ., Richmond.) Mar. 1991 22 p
(NASA-TM-104066; NAS 1.15:104066) Avail: NTIS HC/MF A03 CSCL 11C

Two series of imide/arylene either block copolymers were prepared using an arylene ether block and either an amorphous or semi-crystalline imide block. The resulting copolymers were characterized and selected physical and mechanical properties were determined. These results, as well as comparisons to the homopolymer properties, are discussed. Author

N91-21309*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
A SIMPLE TEST FOR THERMOMECHANICAL EVALUATION OF CERAMIC FIBERS
Gregory N. Morscher (Case Western Reserve Univ., Cleveland, OH.) and James A. DiCarlo Apr. 1991 10 p
(NASA-TM-103767; E-6029; NAS 1.15:103767) Avail: NTIS HC/MF A02 CSCL 11C

A simple bend stress relaxation (BSR) test was developed to measure the creep related properties of ceramic fibers and whiskers. The test was applied to a variety of commercial and developmental Si based fibers to demonstrate capabilities and to evaluate the relative creep resistance of the fibers at 1200 to 1400 C. The implications of these results and the advantages of the BSR test over typical tensile creep tests are discussed. Author

N91-21310# Pacific Northwest Lab., Richland, WA.
VIBRATIONAL FREQUENCIES FOR MODEL SILICATES: EXTENSIONS BEYOND MOLECULAR PROPERTIES
K. F. Ferris and S. M. Risser Feb. 1991 8 p Presented at the Fall Meeting of the Materials Research Society, Boston, 24 Nov. - 1 Dec. 1990
(Contract DE-AC06-76RL-01830)
(DE91-008828; PNL-SA-18622; CONF-901105-103) Avail: NTIS HC/MF A02

The investigation of surface properties for ceramic materials often focuses on molecular properties, both in terms of model systems and methods. Typically, we use molecular species (i.e., SiO4H4, H3SiOH) to represent silica surfaces, often resulting in poor prediction of absorption phenomena. Dielectric effects, even when approximated by electrostatic and polar interactions, can have significant effects on the charge distribution and surface absorption characteristics of model molecular complexes. In this paper, we report on the effect of the surrounding matrix on the harmonic vibrational frequencies by employing reaction field techniques in electronic structure calculations. Comparisons of molecular-based to reaction field affected properties will be made to illustrate the extensions of the molecular to the extended network domain. DOE

N91-21311# Pacific Northwest Lab., Richland, WA.
ENGINEERING PROPERTY LIMITATIONS OF STRUCTURAL CERAMICS AND CERAMIC COMPOSITES ABOVE 1600 C
E. L. Courtright Jan. 1991 34 p Presented at the 15th Annual Conference on Composites and Advanced Ceramics, Cocoa Beach, 13-16 Jan. 1991
(Contract DE-AC06-76RL-01830)
(DE91-009105; PNL-SA-18908; CONF-910162-4) Avail: NTIS HC/MF A03

Current high temperature performance limitations for structural ceramics associated with design related requirements, e.g., creep, fracture toughness, fatigue, and oxidation resistance are reviewed. Non-oxide ceramics exhibit good strength at low temperatures, but do not retain their strength at high temperatures and generally do not have adequate oxidative stability. While many oxides are thermochemically stable at high temperatures in oxidizing atmospheres, the rate of oxygen permeation is very high and this leads to interface degradation when non-oxide fibers are used as reinforcements. Most oxides also exhibit poor high temperature strength and creep resistance, but recent research suggests that acceptable levels of creep resistance may be achievable in single crystals. While toughness in a ceramic matrix composite is generally thought to be a function of interface sliding between fiber and matrix coupled with other crack deflection processes, adequate matrix toughness is also required. Cyclic fatigue resistance is another performance limiting concern in ceramic matrix composites. DOE

N91-21312# Lawrence Livermore National Lab., CA.
ORGANIC AEROGELS: A NEW TYPE OF ULTRASTRUCTURED POLYMER
R. W. Pekala, C. T. Alviso, and J. D. LeMay 1 Feb. 1991 23 p Presented at the 5th International Conference on Ultrastructure Processing of Ceramics, Glasses, Composites and Advanced Optical Materials, Orlando, 17-21 Feb. 1991
(Contract W-7405-eng-48)
(DE91-008500; UCRL-JC-106520; CONF-910291-1) Avail: NTIS HC/MF A03

Organic aerogels with different ultrastructures can be successfully synthesized from the aqueous sol-gel polymerization of the following: (1) resorcinol with formaldehyde; or (2) melamine with formaldehyde. In addition, RF aerogels can be pyrolyzed in an inert atmosphere to give vitreous carbon aerogels. The resorcinol/sodium carbonate ratio is the major variable in the RF polymerization while pH and acid type regulate the MF polymerization. Mechanical property, TEM, and surface area data provide evidence that organic aerogels are similar to their silica counterparts. Based upon these data, we are continuing to explore commonalities between inorganic and organic aerogels so that a universal model might be developed for the structure and properties of these unique materials. Such a model would have a major impact upon the materials science community by opening up new routes for the nanodesign of microporous materials with novel compositions, ultrastructures, and properties. DOE

N91-21313# Pacific Northwest Lab., Richland, WA.
CONTRIBUTIONS OF CONFORMATIONAL AND STRUCTURAL DEFECTS TO THE HYPER-POLARIZABILITIES OF POLYMERS
S. M. Risser and K. F. Ferris Feb. 1991 10 p Presented at the Fall Meeting of the Materials Research Society, Boston, 24 Nov. - 1 Dec. 1990
(Contract DE-AC06-76RL-01830)
(DE91-009042; PNL-SA-18587; CONF-901105-107) Avail: NTIS HC/MF A02

The extent of the delocalized (pi) electron network is of prime importance in determining hyperpolarizabilities of conjugated molecules. Thus, for conjugated polymers, disruptions to this continuous order such as structural and/or conformational defects may have a large influence on the hyperpolarizabilities. Semiempirical electronic structure calculations were performed for a series of model compounds such as polyenes and polyphosphazenes to determine the effects of structural and conformational defects on the hyperpolarizabilities. Briefly, it was found that structural and conjugational defects enhance the hyperpolarizabilities of polyenes, but have little influence on polyphosphazenes due to their limited (pi) delocalization. DOE

N91-21314# Sandia National Labs., Albuquerque, NM.
AN EVALUATION OF THE EFFECTS OF VARYING COMPOSITION AND PROCESSING ON SEVERAL ENCAPSULATING RESINS
K. B. Wischmann and E. V. Thomas Jan. 1991 27 p
(Contract DE-AC04-76DP-00789)
(DE91-009101; SAND-89-1023) Avail: NTIS HC/MF A03

This investigation describes how a statistically designed experiment can be useful to characterize the relationship between a fundamental material property such as the glass transition temperature, Tg, and various processing parameters, e.g., composition, cure time, and temperature. To illustrate, formulation weighing errors can have a dramatic affect on material properties such as thermal, mechanical, and electrical properties. The glass transition temperature was selected for monitoring because it represents the materials state of cure and it is relatively easy to determine. Specifically, EPON 828 systems cured with diethanolamine and Shell Z, respectively, were investigated plus a mixture of the latter that employed aluminum oxide as a filler. This investigation showed that Tg changed very little with cure temperature in the DEA system compared to Shell Z, whereas the latter system appeared to display synergistic effects contrary to the DEA system. In the filled formulation, loading level had very little effect on Tg. The significance of this study is that the relationship between Tg, the composition and processing factors can be used to help diagnose the cause of misprocessed material. DOE

N91-21315# Ohio State Univ., Columbus. Dept. of Physics.
THEORY OF STRUCTURE AND PROPERTIES OF HYDROGENATED AMORPHOUS SILICON
Guido L. Chiarotti, R. Car, F. Buda, and M. Parrinello (International School for Advanced Studies, Trieste, Italy) 1990 8 p Presented at the 20th International Union of Pure and Applied Physics of Semiconductors, Thessaloniki (Greece), 6-10 Aug. 1990
(Contract DE-FG02-88ER-45347)
(DE91-009353; CONF-900866-2) Avail: NTIS HC/MF A02

A computer model was generated of hydrogenated amorphous silicon by first-principles molecular dynamics. The results are in good agreement with the available experimental data, and provide new insight into the microscopic structure of this material. This should lead to a better understanding of the hydrogenation process. DOE

N91-21316# Georgia Inst. of Tech., Atlanta. School of Chemistry and Biochemistry.
THE ORGANIC CHEMISTRY OF CONDUCTING POLYMERS
L. M. Tolbert 17 Feb. 1991 18 p
(Contract DE-FG05-85ER-45194)
(DE91-009520; DOE/ER-45194/6) Avail: NTIS HC/MF A03

This report contains sections on (1) structure of the soliton. Resonance-stabilized carbanions are used as soliton model compounds. (2) Interchain charge transport. Mechanisms for interchain charge transfer are divided into two classes, those involving electron transfer between neutral and charged solitons and those involving bipolarons. (3) Proton-transfer doping. N-doping was achieved using a strong base and a carbon acid precursor polymer. (4) Charge-transfer heteropolymers. Copolymerizations involving pyrrole and benzoquinone; thiophene and benzeoquinone; pyrrole and dimetheory benzene; and thiophene and dimethoxy-benzaldehyde. DOE

N91-21317# North Carolina State Univ., Raleigh. Dept. of Materials Science and Engineering.
INTEGRATED SYNTHESIS AND POST PROCESSING OF SILICON CARBIDE AND ALUMINUM NITRIDE Interim Technical Report, 15 Sep. 1989 - 14 Sep. 1990
A. I. Kingon, Robert F. Davis, and A. K. Singh 13 Dec. 1990 4 p
(Contract DAAL03-89-K-0131)
(AD-A230810) Avail: NTIS HC/MF A01 CSCL 07/2

Synthesis of nonoxide powders in a nonthermal (microwave) plasma was demonstrated, using SiC, Si3N4 and Si as model materials. Particle sizes are ultrafine, 2 to 5 nm. Compositions and structures have been characterized. Equipment has been developed and characterized. Creep of polycrystalline AlN has been investigated for the first time. Mechanisms are identified. GRA

N91-21318# Illinois Univ., Urbana.
STRENGTH OF POLYMER INTERFACES Final Report, Jan. 1986 - Jan. 1989
R. P. Wool 25 Nov. 1990 51 p
(Contract DAAL03-86-K-0034)
(AD-A230839; ARO-22966.3-MS) Avail: NTIS HC/MF A04 CSCL 07/6

Studies of strength development at polymer-polymer interfaces are examined and applications to welding of similar and dissimilar polymers are considered. The fracture properties of the weld, namely, fracture stress, fracture energy, Glc, fatigue crack propagation rate da/dN, and microscopic aspects of the deformation process are determined using compact tension, wedge cleavage, and double cantilever beam healing experiments. The mechanical properties are related to the structure of the interface via microscopic deformation mechanisms involving disentanglement and bond rupture. The time dependent structure of the welding interface is determined in terms of the molecular dynamics of the

polymer chains, the chemical compatibility, and the fractal nature of diffuse interfaces. Several experimental methods are used to probe the weld structure and compare with theoretical scaling laws. Results are given for symmetric amorphous welds, incompatible and compatible asymmetric amorphous welds, incompatible semicrystalline and polymer-metal welds. The relevance of interface healing studies to thermal, friction, solvent, and ultrasonic welds is discussed. GRA

N91-21319# Massachusetts Univ., Amherst. Dept. of Polymer Science and Engineering.
SYNTHESIS, STRUCTURE, AND PROPERTIES OF SEGMENTED POLYURETHANES Final Report, 15 Aug. 1987 - 14 Aug. 1990
William J. MacKnight Oct. 1990 5 p
(Contract DAAL03-87-K-0075)
(AD-A230966; ARO-23941.3-CH) Avail: NTIS HC/MF A01 CSCL 07/3

The effect of the introduction of mesogenic groups on the properties and structure of segmented polyurethanes was investigated. The objectives were to determine to what extent the phase behavior of such polyurethanes is controlled by the phase behavior of the mesogen and the effect of structural considerations such as hydrogen bonding and asymmetric placement of methyl groups on the phase behavior. A summary of the most important results appears in the final report. GRA

N91-21320# California Univ., Santa Barbara. Dept. of Materials.
TRACTABLE HIGH PERFORMANCE POLYMERS Final Technical Report, 1 Sep. 1988 - 31 Aug. 1990
P. Smith, A. J. Heeger, D. Pearson, and H.-W. Schmidt 31 Aug. 1990 8 p
(Contract DAAL03-88-K-0121)
(AD-A231072; ARO-26130.9-MS-A) Avail: NTIS HC/MF A02 CSCL 07/6

The program of Tractable High Performance Polymers was an interdisciplinary research effort to develop the science and technology of synthesis, molecular characterization, processing and solid state characterization of novel tractable high performance rod-like polymers through different concepts of side group modification. Theoretical models for the mechanical behavior of oriented crystalline polymers and high-modulus polymers were developed. The influence of flexible alkyl side chains of rod-like polymers on the mechanical properties of highly oriented structures was theoretically analyzed and experimentally verified with poly(hexl isocyanate). The role of hydrogen bonding in controlling the tensile deformation was investigated by solid state NMR. A variety of tractable para-linked aromatic LC polyesters, which were amorphous, were synthesized and fully characterized by several techniques. The tractability was achieved by the incorporation of novel arylsubstituents and non-coplanar monomers into the chemical structure. These materials were processed from the liquid crystalline phase and then mechanically deformed through tensile processes. GRA

N91-21321# Texas Univ., Arlington. Center for Advanced Polymer Research.
ELECTRONIC AND IONIC TRANSPORT IN PROCESSABLE CONDUCTING POLYMERS Quarterly Report, 1 Oct. - 31 Dec. 1990
Martin Pomerantz, John R. Reynolds, Krishnan Rajeshwar, and Dennis S. Marynick 16 Jan. 1991 6 p
(Contract N00014-90-J-1320)
(AD-A231293; TR-24) Avail: NTIS HC/MF A02 CSCL 07/6

Symmetrically and unsymmetrically substituted poly(di-2-thienyl-2,5 dialkoxy-p-phenylenes) were prepared and studied. X ray studies have shown that the unsymmetrically substituted polymer is completely amorphous while the symmetric polymer exhibits a high level of crystallinity. The dihexadecyloxy derivative was observed to be birefringent and, after NOPF6 doping, a film of this polymer shows a conductivity of 3 OHM per centimeter. A water soluble benzylsulfonate derivative of Kevlar was prepared and a polypyrrole film formed with this as the electrolyte shows a conductivity of ca. 10 OHM per centimeter. Polypyrrole/naphthalene sulfonate thin films can be used to detect ppb quantities of hydrazine in the presence of ammonia. A new technique which combines cyclic voltammetry with Raman scattering was developed. GRA

N91-21322# International Business Machines Corp., San Jose, CA.
OBSERVATION OF THE PHOTOREFRACTIVE EFFECT IN A POLYMER Interim Technical Report
S. Ducharme, J. C. Scott, R. J. Twieg, and W. E. Moerner 10 Dec. 1990 18 p
(Contract N00014-84-C-0708)
(AD-A231339; IBM-RR-RJ7874; ONR-TR-28) Avail: NTIS HC/MF A03 CSCL 07/6

The observation is reported of the photorefractive effect in an amorphous electro-optic material, the nonlinear polymer bisphenol A diglycidyl ether 4-nitro-1,2,phenylenediamine (bisA-NPDA) make photoconductive by doping with the hole transport agent diethylaminobenzaldehyde-diphenyl hydrazone (DEH). The gratings formed exhibit: dynamic writing and erasure, strong electric field dependence, polarization anisotropy, diffraction efficiencies up to 6 x 10 -5 in a 356 micron film, and large estimated photorefractive space-charge fields. Continuous realignment of the nonlinear molecules in the polymer permits external control of the grating readout independent of the space charge field formed. GRA

N91-21323# Massachusetts Inst. of Tech., Cambridge.
ARTIFACT DIAMOND CHARACTERIZATION Progress Report, 1 Jul. - 30 Dec. 1990
Karen K. Gleason 1990 2 p
(Contract N00014-90-J-1901)
(AD-A231555) Avail: NTIS HC/MF A01 CSCL 07/2

Three CVD diamond films were produced in a hot-filament reactor using acetone as the carbon source. The acetone was enriched 33 percent at the methyl carbon, and the total gas-phase concentrations were 5.3, 6.4, and 7.4 percent. Static solid-state NMR measurements of hydrogen concentration, sp2/sp3 carbon bonding environments, and carbon-13 spin-lattice relaxation have been made on these films while they remain intact on their substrates. The hydrogen concentration was found to be below 1 at. percent in each film. Increasing sp2 content is found with increasing gas-phase carbon concentration. Ongoing measurements are aimed at understanding the sp3 region of the NMR spectra and its relationship to Raman measurements of these films. An increased concentration of defect centers decreased the spin-lattice relaxation time constant from 18 s to 1 s as the gas-phase carbon concentration increased. GRA

28 PROPELLANTS AND FUELS

Includes rocket propellants, igniters, and oxidizers; their storage and handling procedures; and aircraft fuels.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *44 Energy Production and Conversion.*

N91-21324# Rensselaer Polytechnic Inst., Troy, NY. Dept. of Chemical and Environmental Engineering.
AEROBIC PRODUCTION OF ETHANOL Final Report
L. S. Clesceri and H. R. Bungay Jan. 1990 34 p Sponsored in part by New York State Energy Research and Development Authority, Albany
(PB91-119172; NYSERDA-90-1) Avail: NTIS HC/MF A03 CSCL 07D

A computer-controlled continuous culture of yeast converted glucose to ethanol at excellent rates on a per-cell basis. This highly unconventional aerobic bioprocess makes use of oxidoreductive metabolism induced by concentrations of glucose that overload respiratory capacity and dump glucose into the ethanol pathway. Unfortunately, this yeast strain lost this high

productivity when ethanol approached the concentration required by a commercially feasible process. These results point the way for a new method for making ethanol is an organism can be found that is less inhibited by its main product. GRA

N91-21325# Lehigh Univ., Bethlehem, PA.
HIGH OCTANE ETHERS FROM SYNTHESIS GAS-DERIVED ALCOHOL
K. Klier, R. G. Herman, R. D. Bastian, and S. DeTavernier Jan. 1991 44 p
(Contract DE-AC22-90PC-90044)
(DE91-008367; DOE/PC-90044/1) Avail: NTIS HC/MF A03

The objective of the proposed research is to synthesize high octane ethers directly from coal-derived synthesis gas via alcohol mixtures that are rich in methanol and isobutanol. The overall scheme involves gasification of coal, purification and shifting of the synthesis gas, higher alcohol synthesis, and direct synthesis of ethers. Commercial acid and superacid resin catalysts were obtained and tested under one set of conditions to compare the activities and selectivities for forming the unsymmetric methyl isobutyl ether (MIBE) by coupling methanol with isobutanol. It was found that both Nafion-H microsaddles and Amberlyst-15 resins are active for this synthesis reaction. While and the Nafion-H catalyst does form the MIBE product fairly selectively under the reaction conditions utilized, the Amberlyst-15 catalyst formed dimethyl ether (DME) as the major product. In addition, significantly larger quantities of the C4 hydrocarbon products were observed over the Amberlyst-15 catalyst at 123 C and 13.6 atm. It has been demonstrated that methyl tertiary butyl ether (MTBE) MIBE, DME and diisobutylether (DIBE) are separated and quantitatively determined by using the proper analytical conditions. In order to gain insight into the role of superacidity in promoting the selective coupling of the alcohols to form the unsymmetric ether, the strengths of the acid sites on the catalysts are being probed by thermometric titrations in non-aqueous solutions. DOE

N91-21326# Weapons Systems Research Lab., Adelaide (Australia).
BASIC RHEOLOGY AND ITS APPLICATION TO NITROCELLULOSE PROPELLANT PROCESSING BY SCREW MIX-EXTRUDERS General Document
R. C. Warren Sep. 1990 56 p
(AD-A230872; WSRL-GD-28/90; DODA-AR-006-450) Avail: NTIS HC/MF A04 CSCL 11/9

This document is intended to provide an introductory review of the rheology of propellant doughs and the propellant mixing process. The fundamental rheological quantities describing the flow of propellant doughs in mixing and extrusion are described, and the molecular factors affecting flow are discussed. Batch mixing is analysed in terms of the fundamental parameters which have been introduced, and a method of analysing screw mix-extrusion in a similar way is suggested. GRA

N91-21327# Army Belvoir Research and Development Center, Fort Belvoir, VA.
ELASTOMER COMPATIBILITY WITH LIQUID PROPELLANT AT ELEVATED TEMPERATURE Final Technical Report, Jan. - Dec. 1989
Henry O. Feuer, Jr. and Alan R. Teets Dec. 1990 47 p
(AD-A230973; BRDEC-TR-2498) Avail: NTIS HC/MF A03 CSCL 19/1

This report details the investigation and results in the evaluation of the compatibility of various elastomeric compounds that may be used in the transfer and containment of liquid propellants (LPs) currently under development by the U.S. Army. Hydroxyl Ammonium Nitrate (HAN)-based LPs are monopropellants composed of an oxidizer (HAN) and a fuel (an aliphatic amine nitrate). The HAN-based LP used in this study has the designation of 1846. It is a water-based propellant with a density of approximately 1.4g/cc. The fuel component of the LP-1846 is triethanol ammonium nitrate. The Army foresees using LP-1846 in a regenerative injection system for 155mm guns. The regenerative system involves the use of a piston forcing the LP, in the form of a jet or a spray, into the gun chamber during the combustion process, thereby controlling propellant combustion. GRA

N91-21328# Ballistic Research Labs., Aberdeen Proving Ground, MD.
HEATS OF EXPLOSION AT LOW PRESSURES, 2 Final Report, Oct. 1989 - Jan. 1990
Arthur Cohen, Martin S. Miller, Hughes E. Holmes, and Bonita A. Huntley Dec. 1990 29 p
(DA Proj. 1L1-61102-AH-43)
(AD-A231020; BRL-TR-3188) Avail: NTIS HC/MF A03 CSCL 19/1

An alternate method for estimating the thermal energy (E) of propellant combustion products in guns at low pressures has been investigated. The method assumes that for same pressure levels in guns and calorimeter bombs, E is equal to the measured heat of explosion (HEX). HEX have been measured in calorimeters for M30 and XM39 at low initial pressures (Po) (25-1015 psia). Low loading densities (LD) (.0002-012 g/cc) were used to minimize the uncertainty in the calorimeter pressure level during combustion. The values for HEX, at the higher LD, imply that combustion is complete. As Pa and Ld decrease, a fall off in HEX from the values obtained at the higher LD is observed. This is attributed to a change in the combustion mechanism which leads to incomplete combustion. HEX values in the fall off region are also dependent of the physical environment in the calorimeter. This implies that some knowledge of the physical processes which occur during combustion at low pressures in calorimeter bombs (and guns) is required to assess the usefulness of estimating values for E from the HEX measurements. GRA

N91-21329# Louisiana State Univ., Baton Rouge. Dept. of Physics and Astronomy.
THEORETICAL STUDIES OF HIGHLY ENERGETIC CBES MATERIALS Final Report, 2 Mar. - 31 May 1987
Nathan E. Brener, Neil R. Kestner, and Joseph Callaway Dec. 1990 73 p
(Contract F04611-87-C-0026)
(AD-A231340; AL-TR-90-060) Avail: NTIS HC/MF A04 CSCL 19/1

This is the final report of a theoretical research investigation which was undertaken to identify new propellants with revolutionary performance. A general method of locating new candidates was developed. By use of this method, several candidates were identified, including N6 and N4, which are predicted to have better performance (specific impulse) than liquid hydrogen and oxygen. Condensed phase properties of azides and promising propellant candidates were also determined by use of a simulated annealing program. GRA

N91-21330# Ballistic Research Labs., Aberdeen Proving Ground, MD.
COMBUSTION TESTS OF BLACK-POWDER SUBSTITUTES FOR THE HAND-HELD SIGNAL FLARE Final Report, Aug. 1988 - Aug. 1989
William F. McBratney, Martin S. Miller, and Ronald A. Sasse Jan. 1991 56 p
(AD-A231501; BRL-MR-3891) Avail: NTIS HC/MF A04 CSCL 19/1

Replacement of the black powder in hand-held signal flares with energetic materials of more consistent combustion properties is being studied. The black powder is currently used in both pressed and granular states to provide for the functions of ignition, propulsion, timing, payload expulsion, and ignition of the illuminant. The laboratory work described in this report is intended to provide a rational basis for evaluating candidate materials to replace black powder in these various functions. Linear burning rates of pressed materials were determined over the pressure range of 2 to 4 MPa for Goex black powder, Pyrodex RS, and four black powder substitutes. Fixtures were designed and instrumented to simulate those flare functions requiring granular forms of the energetic material. Temperature and pressure data from these fixtures permit

a comparison of the performance of the candidate substitutes relative to black powder in the motor ignition and payload expulsion phases of the flare operation. GRA

29 MATERIALS PROCESSING

Includes space-based development of products and processes for commercial applications.

For biological materials see *55 Space Biology*.

N91-21331*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

PROCEEDINGS OF THE FIRST WORKSHOP ON CONTAINERLESS EXPERIMENTATION IN MICROGRAVITY

E. H. Trinh, ed. 1 May 1990 562 p Workshop held in Pasadena, CA, 17-19 Jan. 1990

(NASA-CR-187806; JPL-Publ-90-30; NAS 1.26:187806) Avail: NTIS HC/MF A24 CSCL 22A

The goals of the workshop were first to provide scientists an opportunity to acquaint themselves with the past, current, and future scientific investigations carried out in the Containerless Science programs of the Microgravity Science and Applications Div. of NASA, as well as ESA and Japanese Space Agencies. The second goal was to assess the technological development program for low gravity containerless experimentation instruments. The third goal was to obtain recommendations concerning rigorous but feasible new scientific and technological initiative for space experiments using noncontact sample positioning and diagnostic techniques. For individual titles, see N91-21332 through N91-21377.

N91-21332*# National Aeronautics and Space Administration, Washington, DC.

CHARGE OF THE CONTAINERLESS EXPERIMENTATION IN MICROGRAVITY

Mark C. Lee *In* JPL, Proceedings of the First Workshop on Containerless Experimentation in Microgravity 1 May 1990 p 5-36 (For primary document see N91-21331 13-29)

Avail: NTIS HC/MF A24 CSCL 22A

The experimentation was undertaken to study the elimination or reduction of surface contamination for which there is adequate Earth-based technology along with the reduction of dynamic nucleation for which there a paucity of reliable data. One objective is to delineate scientific justification of the U.S. Containerless Experimentation Program in Microgravity for the next decade and beyond. Another objective is for the guidance of NASA to define the next generation of containerless experimentation instruments in microgravity. E.R.

N91-21333*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

GROUND-BASED AND MICROGRAVITY CONTAINERLESS POSITIONING TECHNOLOGIES AND FACILITIES

Martin Barmatz *In its* Proceedings of the First Workshop on Containerless Experimentation in Microgravity 1 May 1990 p 37-53 (For primary document see N91-21331 13-29)

Avail: NTIS HC/MF A24 CSCL 22A

A presentation is given with the following outline: Containerless experiments; Uniqueness of microgravity; Microgravity experiments; Containerless program development; and Accommodating microgravity experiments. Under accommodating comes positioning approaches, space flight facilities, ground based facilities and technology development, and space station facilities. E.R.

N91-21334*# Vanderbilt Univ., Nashville, TN.

VERY HIGH TEMPERATURE CHEMISTRY: SCIENCE JUSTIFICATION FOR CONTAINERLESS EXPERIMENTATION IN SPACE

William H. Hofmeister and Paul Nordine (Containerless Processing, Inc., Kansas City, MO.) *In* JPL, Proceedings of the First Workshop on Containerless Experimentation in Microgravity 1 May 1990 p 54-56 (For primary document see N91-21331 13-29)

Avail: NTIS HC/MF A24 CSCL 22A

A summary is presented of the justification for application of containerless processing in space to high temperature science. Low earth orbit offers a gravitational environment that allows samples to be positioned in an experimental apparatus by very small forces. Well controlled experiments become possible on reactive materials at high temperatures in a reasonably quiescent state and without container contamination. This provides an opportunity to advance the science of high temperature chemistry that can only be realized with a commitment by NASA to provide advanced facilities for in-space containerless study of materials at very high temperature. Author

N91-21335*# Vanderbilt Univ., Nashville, TN.

NASA-SPONSORED CONTAINERLESS PROCESSING EXPERIMENTS

William H. Hofmeister *In* JPL, Proceedings of the First Workshop on Containerless Experimentation in Microgravity 1 May 1990 p 57-76 (For primary document see N91-21331 13-29)

Avail: NTIS HC/MF A24 CSCL 22A

An outline is presented of containerless processing and facilities at Intersonics which is sponsored by NASA. There are electromagnetic, acoustic, and aerodynamic levitation facilities. There are also laser beam and arc lamp heating systems along with state of the art noncontact temperature and optical property measurement facilities. Nonintrusive diagnostic techniques with Laser Induced Fluorescence and mass spectrometer are also available. Controlled atmosphere processing, gas quenching, and proven microgravity processing technology is part of the Intersonics capabilities. E.R.

N91-21336*# Vanderbilt Univ., Nashville, TN. Center for the Space Processing of Engineering Materials.

CONTAINERLESS PROCESSING PROJECTS

In JPL, Proceedings of the First Workshop on Containerless Experimentation in Microgravity 1 May 1990 p 77-98 (For primary document see N91-21331 13-29)

Avail: NTIS HC/MF A24 CSCL 22A

The primary research objective was the examination of fundamental acoustics of the Drop Physics Module. An advanced chamber system was developed for acoustics and sample characterization. Sample interaction with an acoustic field was studied. The shaping of liquid drops by acoustic forces was also examined. The acoustic torque as a function of sample position and shape was studied along with levitated sample stability and the effects of feedback systems. Author

N91-21337*# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).

CONTAINERLESS PROCESSING IN THE EUROPEAN MICROGRAVITY PROGRAMME

P. Behrmann *In* JPL, Proceedings of the First Workshop on Containerless Experimentation in Microgravity 1 May 1990 p 99-112 (For primary document see N91-21331 13-29)

Avail: NTIS HC/MF A24 CSCL 22A

Reasonable acoustic levitation for undercooled melts in space was obtained, but some residual instabilities in times of high thermal transients need to be eliminated. Electrostatic levitation was developed with the acoustic levitator with similar applications in mind. The system tested used a tetrahedral electrode configuration with unchanged samples. ESA's involvement in electromagnetic levitation is concentrated on accommodation studies for the European Containerless Processing Lab for the Space Station Freedom. The gas film technique is based on the processing of samples confined by porous walls. Air flow through the walls create air cushions which inhibit wall contact. This technique is particularly promising for glasses. Author

N91-21338*# National Aerospace Lab., Tokyo (Japan).

THE JAPANESE CONTAINERLESS EXPERIMENTS

Hisao Azuma *In* JPL, Proceedings of the First Workshop on

Containerless Experimentation in Microgravity 1 May 1990 p 113-11 (For primary document see N91-21331 13-29)
Avail: NTIS HC/MF A24 CSCL 22A

There are three sets of Japanese containerless experiments. The first is Drop dynamics research. It consists of acoustic levitation and large amplitude drop oscillation. The second is Optical materials processing in an acoustic levitation furnace. And the third is Electrostatic levitator development by two different Japanese companies. E.R.

N91-21339*# Wisconsin Univ., Madison. Dept. of Materials Science and Engineering.
CONTAINERLESS PROCESSING OF UNDERCOOLED MELTS
J. H. Perepezko *In* JPL, Proceedings of the First Workshop on Containerless Experimentation in Microgravity 1 May 1990 p 133-17 (For primary document see N91-21331 13-29)
Avail: NTIS HC/MF A24 CSCL 22A

All practical solidification processes involve some level of melt undercooling. Usually in bulk liquids crystallization is initiated at a heterogeneous nucleation site at low undercooling. The realization of appreciable levels of liquid undercooling requires some control over the kinetics of crystal nucleation. One level of control is available in containerless processing where the capability to melt and solidify samples without a container removes a major source of impurities and heterogeneous nucleation sites which can be effective in promoting large undercooling and in studying other potential nucleants. The microgravity environment offers a unique opportunity for containerless processing of large liquid samples with negligible melt disturbance and continuous temperature measurement throughout processing. Perhaps the most important potential for microgravity containerless processing lies in the significant structural control to develop distinct microstructures and metastable phases during solidification at high undercooling.
Author

N91-21340*# Arizona Univ., Tucson. Dept. of Materials Science and Engineering.
CONTAINERLESS SYNTHESIS OF INTERESTING GLASSES
Michael C. Weinberg *In* JPL, Proceedings of the First Workshop on Containerless Experimentation in Microgravity 1 May 1990 p 178-20 Sponsored in part by NASA, Washington, DC (For primary document see N91-21331 13-29)
Avail: NTIS HC/MF A24 CSCL 22A

One aspect of containerless glass experimentation was thoroughly examined: glass forming ability. It is argued that although containerless processing will abet glass formation, other ground-based methods can do the job better. However, these methods have limitations, such as sample dimensions and concomitant ability to make property measurements. Most importantly, perhaps, is the observation that glass properties are a function of preparation procedure. Thus, it seems as though there still is an argument for use of containerless processing for glass forming. Author

N91-21341*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
CONTAINERLESS EXPERIMENTS IN FLUID PHYSICS IN MICROGRAVITY
E. H. Trinh *In its* Proceedings of the First Workshop on Containerless Experimentation in Microgravity 1 May 1990 p 201-214 (For primary document see N91-21331 13-29)
Avail: NTIS HC/MF A24 CSCL 22A

The physical phenomena associated with the behavior of liquid samples freely suspended in low gravity must be thoroughly understood prior to undertaking detailed scientific studies of the materials under scrutiny. The characteristics of molten specimens under the action of containerless positioning stresses must be identified and separated from the specific phenomena relating to the absence of an overwhelming gravitational field. The strategy designed to optimize the scientific return of reliable experimental data from infrequent microgravity investigations should include the gradual and logical phasing of more sophisticated studies building on the accumulated results from previous flight experiments. Lower temperature fluid physics experiments using model materials can provide a great deal of information that can be useful in analyzing the behavior of high temperature melts. The phasing of the experimental capabilities should, therefore, also include a gradual build-up of more intricate and specialized diagnostic instrumentation and environmental control and monitoring capabilities. Basic physical investigations should also be distinguished from specific materials technology issues. The latter investigations require very specific high temperature (and high vacuum) devices that must be thoroughly mastered on the ground prior to implementing them in space. Author

N91-21342*# Lehigh Univ., Bethlehem, PA. Dept. of Physics.
REAL-TIME MEASUREMENT OF MATERIALS PROPERTIES AT HIGH TEMPERATURES BY LASER PRODUCED PLASMAS
Yong W. Kim *In* JPL, Proceedings of the First Workshop on Containerless Experimentation in Microgravity 1 May 1990 p 217-22 (For primary document see N91-21331 13-29)
Avail: NTIS HC/MF A24 CSCL 22A

Determination of elemental composition and thermophysical properties of materials at high temperatures, as visualized in the context of containerless materials processing in a microgravity environment, presents a variety of unusual requirements owing to the thermal hazards and interferences from electromagnetic control fields. In addition, such information is intended for process control applications and thus the measurements must be real time in nature. A new technique is described which was developed for real time, in-situ determination of the elemental composition of molten metallic alloys such as specialty steel. The technique is based on time-resolved spectroscopy of a laser produced plasma (LPP) plume resulting from the interaction of a giant laser pulse with a material target. The sensitivity and precision were demonstrated to be comparable to, or better than, the conventional methods of analysis which are applicable only to post-mortem specimens sampled from a molten metal pool. The LPP technique can be applied widely to other materials composition analysis applications. The LPP technique is extremely information rich and therefore provides opportunities for extracting other physical properties in addition to the materials composition. The case in point is that it is possible to determine thermophysical properties of the target materials at high temperatures by monitoring generation and transport of acoustic pulses as well as a number of other fluid-dynamic processes triggered by the LPP event. By manipulation of the scaling properties of the laser-matter interaction, many different kinds of flow events, ranging from shock waves to surface waves to flow induced instabilities, can be generated in a controllable manner. Time-resolved detection of these events can lead to such thermophysical quantities as volume and shear viscosities, thermal conductivity, specific heat, mass density, and others. Author

N91-21343*# California Inst. of Tech., Pasadena.
THERMODYNAMIC PROPERTIES AND CRYSTALLIZATION KINETICS AT HIGH LIQUID UNDERCOOLING
Hans J. Fecht *In* JPL, Proceedings of the First Workshop on Containerless Experimentation in Microgravity 1 May 1990 p 222-22 Sponsored by NASA, Washington, DC (For primary document see N91-21331 13-29)
Avail: NTIS HC/MF A24 CSCL 22A

The heat capacities of liquid and crystalline Au-Pb-Sb alloys in the glass-forming composition range were measured with droplet emulsion and bulk samples. Based on the measured C(sub p) data, the entropy, enthalpy, and Gibbs free energy functions of the eutectic, solid mixture, and undercooled liquid were determined as a function of undercooling and compared with theoretical predictions. The results indicate an isentropic temperature at 313 + or - 5 K, which agrees well with experimental data for the glass transition. A kinetics analysis of the nucleation undercooling response suggests that the proper choice for the Gibbs free energy change during crystallization is most important in analyzing the nucleation kinetics. By classical nucleation theory, the prefactors obtained, based on a variety of theoretical predictions for the driving force, can differ by six orders of magnitude. If the nucleation

rates are extrapolated to high undercooling, the extrapolations based on measured heat capacity data show agreement, whereas the predicted nucleation rates are inconsistent with results from drop tower experiments. The implications for microg experiments are discussed. Author

N91-21344*# Rice Univ., Houston, TX.
THERMOPHYSICAL PROPERTY MEASUREMENTS IN ELECTROMAGNETIC LEVITATORS
Robert H. Hauge, P. Lee, Nathan Norem, Tarik Baykara, and John L. Margrave *In* JPL, Proceedings of the First Workshop on Containerless Experimentation in Microgravity 1 May 1990 p 229-23 Prepared in cooperation with Laser Applications Research Center, The Woodlands, TX (For primary document see N91-21331 13-29)
Avail: NTIS HC/MF A24 CSCL 22A

Proper measurements of thermophysical properties of hot levitated liquid drops require the following: accurate temperature measurement (brightness measurement, emissivity measurement); precise drop shape measurements with submillisecond time resolution (density determination, rotational and vibrational shape information); precise control of drop shape (high symmetry variable gap levitators); accurate energy transfer measurements (direct measurements of energy transfer rates for defined gas flows over samples with quantitative measurements of energy transfer rates for defined flows over samples with known shapes); and precise measurements of repetitive sample motions (rapid repetitive shape measurements, frequency measurements with reflected laser light, measurements in the levitator and as a freely falling drop). Recent advances in coil design and control of sample rotation in an electromagnetic levitator are discussed with respect to the above requirements. Author

N91-21345*# Intersonics, Inc., Northbrook, IL.
NCTM OF LIQUIDS AT HIGH TEMPERATURES USING POLARIZATION TECHNIQUES
Shankar Krishnan, J. K. Richard Weber, Paul C. Nordine, and Robert A. Schiffman *In* JPL, Proceedings of the First Workshop on Containerless Experimentation in Microgravity 1 May 1990 p 237-24 (For primary document see N91-21331 13-29)
Avail: NTIS HC/MF A24 CSCL 22A

Temperature measurement and control is extremely important in any materials processing application. However, conventional techniques for non-contact temperature measurement (mainly optical pyrometry) are very uncertain because of unknown or varying surface emittance. Optical properties like other properties change during processing. A dynamic, in-situ measurement of optical properties including the emittance is required. Intersonics is developing new technologies using polarized laser light scattering to determine surface emittance of freely radiating bodies concurrent with conventional optical pyrometry. These are sufficient to determine the true surface temperature of the target. Intersonics is currently developing a system called DAPP, the Division of Amplitude Polarimetric Pyrometer, that uses polarization information to measure the true thermodynamic temperature of freely radiating objects. This instrument has potential use in materials processing applications in ground and space based equipment. Results of thermophysical and thermodynamic measurements using laser reflection as a temperature measuring tool are presented. The impact of these techniques on thermophysical property measurements at high temperature is discussed. Author

N91-21346*# Rice Univ., Houston, TX. Dept. of Mechanical Engineering and Materials Science.
SURFACE TENSION AND VISCOSITY FROM DAMPED FREE OSCILLATIONS OF VISCOUS DROPLETS Abstract Only
P. V. R. Suryanarayana and Yildiz Bayazitoglu *In* JPL, Proceedings of the First Workshop on Containerless Experimentation in Microgravity 1 May 1990 p 242 (For primary document see N91-21331 13-29)
Avail: NTIS HC/MF A24 CSCL 22A

Damped oscillations of a viscous droplet in vacuum or in an inert gas of negligible density are considered. The dependence of the complex decay factor on the properties of the liquid is investigated for the first time, and numerical results are compared with earlier studies for special cases. A new method is developed to determine both surface tension and viscosity from a single experiment in which the damping rate and frequency of oscillations are measured. The procedure to determine surface tension and viscosity from oscillating levitated liquids is outlined, and results presented for various modes of shape oscillations. Author

N91-21347*# National Inst. of Standards and Technology, Gaithersburg, MD. Thermophysics Div.
A DYNAMIC TECHNIQUE FOR MEASURING SURFACE TENSION AT HIGH TEMPERATURES IN MICROGRAVITY ENVIRONMENT
A. P. Miiller and A. Cezairliyan *In* JPL, Proceedings of the First Workshop on Containerless Experimentation in Microgravity 1 May 1990 p 243-24 (For primary document see N91-21331 13-29)
Avail: NTIS HC/MF A24 CSCL 22A

The feasibility of a dynamic technique for measuring surface tension of liquid metals at high temperatures in a microgravity environment was demonstrated. The basic method involves heating a tubular specimen resistively from ambient temperature through its melting point in about 1 sec by passing an electrical current pulse through it, while simultaneously recording the pertinent experimental quantities. Static equilibrium for the molten specimen is achieved in a microgravity environment by splitting the current after it passes through the specimen tube and returning a fraction along the tube axis, and the remaining fraction outside the specimen. Adjustments to the current split enable a balance between the magnetic and surface tension forces acting on the specimen. Values for surface tension are determined from measurements of the equilibrium dimensions of the molten specimen tube, and the magnitudes of the currents. Rapid melting experiments, performed during microgravity simulations with the NASA KC-135 aircraft, yield a value for the surface tension of copper at its melting point which is in agreement with literature data. Measurements of surface tension of a refractory metal (tantalum) are underway. Author

N91-21348*# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (Germany, F.R.). Projects Div.
EXPERIMENTS FOR ELECTROMAGNETIC LEVITATION IN MICROGRAVITY
R. Willnecker and I. Egry *In* JPL, Proceedings of the First Workshop on Containerless Experimentation in Microgravity 1 May 1990 p 248-25 (For primary document see N91-21331 13-29)
Avail: NTIS HC/MF A24 CSCL 22A

Containerless processing is a promising research tool for investigating the properties of undercooled melts and their solidification. For conducting samples RF-electromagnetic levitation offers the possibility to obtain large undercoolings by avoiding heterogeneous nucleation at container walls. On earth, however, strong magnetic fields are needed to compensate the gravitational force which imposes a lower limit on the available temperatures and on the accessible undercooling range. Under microgravity conditions the magnetic positioning fields can be minimized and hence, undercooling becomes feasible under ultra-high vacuum conditions and lower temperatures become accessible. In contrast to other undercooling and solidification techniques, electromagnetic levitation allows for diagnostic measurements during the early steps of nucleation and phase selection. Experiments cover a wide field of research topics: nucleation, directional solidification at high velocities, generation of metastable phases, evolution of microstructures, properties of undercooled liquids. Examples from these classes including experiments selected for the IML-2 mission are discussed with emphasis on technical requirements. An overview is given on the German TEMPUS (electromagnetic levitation facility) program. Author

N91-21349*# Dornier-Werke G.m.b.H., Friedrichshafen (Germany, F.R.).
TEMPUS: A FACILITY FOR CONTAINERLESS ELECTROMAGNETIC PROCESSING ONBOARD SPACELAB
H. Lenski and R. Willnecker *In* JPL, Proceedings of the First Workshop on Containerless Experimentation in Microgravity 1 May 1990 p 259-27 Prepared in cooperation with Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne, Germany, F.R. (For primary document see N91-21331 13-29)
Avail: NTIS HC/MF A24 CSCL 22A

The electromagnetic containerless processing facility TEMPUS was recently assigned for a flight on the IML-2 mission. In comparison to the TEMPUS facility already flown on a sounding rocket, several improvements had to be implemented. These are in particular related to: safety; resource management; and the possibility to process different samples with different requirements in one mission. The basic design of this facility as well as the expected processing capabilities are presented. Two operational aspects turned out to strongly influence the facility design: control of the sample motion (first experimental results indicate that crew or ground interaction will be necessary to minimize residual sample motions during processing); and exchange of RF-coils (during processing in vacuum, evaporated sample materials will condense at the cold surface and may force a coil exchange, when a critical thickness is exceeded). Author

N91-21350*# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (Germany, F.R.). Inst. for Space Simulation.
TEMPUS: FIRST RESULTS
P. Neuhaus, G. Lohoefer, I. Egry, and R. Willnecker *In* JPL, Proceedings of the First Workshop on Containerless Experimentation in Microgravity 1 May 1990 p 276-28 (For primary document see N91-21331 13-29)
Avail: NTIS HC/MF A24 CSCL 22A

The electromagnetic levitation facility, TEMPUS, developed by Dornier is designed to operate under microgravity conditions. Compared to terrestrial levitation, microgravity offers the possibility to melt and undercool in ultra high vacuum, thereby, providing an ultra clean environment. The technical concept of the TEMPUS facility was tested on two KC 135 flights and in the Texus 22 mission. Preparative investigations concerning the coil system and the heating and positioning efficiencies were carried out in the TEMPUS laboratory version. Furthermore, temperature-time profiles were determined under various boundary conditions. As a consequence of processing liquid metals under UHV, correct temperature measurement arises as the most critical problem. Experiences with experiments in the TEMPUS laboratory module show that due to the evaporation losses of the sample, the transmission of the CaF2 shielding windows changes drastically during the processing time. The investigation of the effect of contamination on pyrometry and the development of alternative evaporation shielding methods were initiated. During the second KC 135 flight, it was possible to heat up and melt an FeNi sample under He atmosphere. Oscillations of the molten sample, which were excited by switching out the magnetic heating field, could be detected and afterwards analyzed. From the frequency of these oscillations the surface tension of the sample material could be derived. The measurement of the surface tension and viscosity of an undercooled metal is proposed for TEMPUS on IML-2. This document is presented in view graph form. Author

N91-21351*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
RELUCTANT GLASS FORMERS AND THEIR APPLICATIONS IN OPTICAL LENS DESIGN
Edwin C. Ethridge, R. Barry Johnson, and Chen Feng (Alabama Univ., Huntsville.) *In* JPL, Proceedings of the First Workshop on Containerless Experimentation in Microgravity 1 May 1990 p 282-29 (For primary document see N91-21331 13-29)
Avail: NTIS HC/MF A24 CSCL 22A

Over ten years ago, it was shown that glasses with high index of refraction and some with low dispersion could be produced from a number of pure refractory oxides, including the lanthanides, by containerless processing. By containerless processing it is possible to minimize surface heterogeneous nucleation and produce larger glass samples of the materials than by other methods. The use of proposed high temperature containerless processing facilities in space permits the fabrication of benchmark samples of new unique glass compositions for optical property determination as well as for glass formation. It was shown that glasses with high refractive indices and large Abbe numbers can be formulated using this technology. These glasses lie in the classical forbidden region of the glass map. Preliminary study of the impact of having such unusual glasses available for the lens designer was made. Results indicate that significant improvements can be realized over the use of only conventional glasses. A cursory survey of a number of nationally recognized lens designers indicated a general agreement that such glasses would be highly desired and could be expected to lead to completely new designs as well as simplifying existing designs. Author

N91-21352*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
CONTAINERLESS PROTEIN CRYSTAL GROWTH TECHNOLOGY: ELECTROSTATIC MULTIDROP POSITIONER
Won-Kyu Rhim *In its* Proceedings of the First Workshop on Containerless Experimentation in Microgravity 1 May 1990 p 293-297 (For primary document see N91-21331 13-29)
Avail: NTIS HC/MF A24 CSCL 22A

A brief discussion of containerless protein crystal growth in space and a diagram of the electrostatic multidrop positioner are presented. A picture of lysome crystals growing in a drop and a graph of levitation voltage versus time (minutes) are also presented. K.S.

N91-21353*# Delaware Univ., Newark. Dept. of Chemical Engineering.
A SYSTEMATIC INVESTIGATION OF THE PREPARATION AND PROPERTIES OF COMPOSITE CARBON MOLECULAR SIEVES CONTAINING INORGANIC OXIDES Abstract Only
Henry C. Foley *In* JPL, Proceedings of the First Workshop on Containerless Experimentation in Microgravity 1 May 1990 p 298 (For primary document see N91-21331 13-29)
Avail: NTIS HC/MF A24 CSCL 22A

The objective of this research is to define the methodology for the preparation and characterization of new carbon-based molecular sieves with composite structures. Carbon molecular sieves have found increasing application in the field of separation and purification of gases. These materials are relatively easy to prepare and their surfaces can be modified to some extent. It is expected that by combining inorganic oxides with the carbonaceous structure one can begin to design composite materials with a wider range of possible chemical and physical properties. In this way, the IOM-CMS materials may confer distinct advantages over pure carbon molecular sieves, not just for separation, but also for catalysis. The most recent results in the design and characterization of these IOM-CMS materials are reviewed and summarized. Directions for further research are also presented. Author

N91-21354*# Wisconsin Univ., Madison. Dept. of Mechanical Engineering.
SUPERCRITICAL MICROGRAVITY DROPLET VAPORIZATION Abstract Only
J. Hartfield, E. Curtis, and P. Farrell *In* JPL, Proceedings of the First Workshop on Containerless Experimentation in Microgravity 1 May 1990 p 299 (For primary document see N91-21331 13-29)
Avail: NTIS HC/MF A24 CSCL 22A

Supercritical droplet vaporization is an important issue in many combustion systems, such as liquid fueled rocket and compression-ignition (diesel) engines. In order to study the details of droplet behavior at these conditions, an experiment was designed to provide a gas phase environment which is above the critical pressure and critical temperature of a single liquid droplet. In

general, the droplet begins as a cold droplet in the hot, high pressure environment. In order to eliminate disruptions to the droplet by convective motion in the gas, forced and natural convection gas motion are required to be small. Implementation of this requirement for forced convection is straightforward, while reduction of natural convection is achieved by reduction in the g-level for the experiment. The resulting experiment consists of a rig which can stably position a droplet without restraint in a high-pressure, high temperature gas field in microgravity. The microgravity field is currently achieved by dropping the device in the NASA Lewis 2.2 second drop tower. The performance of the experimental device and results to date are presented. Author

N91-21355*# California Univ., Los Angeles. Dept. of Physics.
USING A MICROGRAVITY ENVIRONMENT TO PROBE WAVE TURBULENCE
S. Putterman, G. Williams, and Martin Barmatz (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) *In* JPL, Proceedings of the First Workshop on Containerless Experimentation in Microgravity 1 May 1990 p 300-30 (For primary document see N91-21331 13-29)
Avail: NTIS HC/MF A24 CSCL 22A

The experimental key to observing stochasticity or turbulence in a distribution of interacting propagating waves is the achievement of high amplitude and the use of a medium with a large coefficient of nonlinearity. The research indicates that capillary waves are the best means of observing this phenomenon; however, gravitational modifications of the capillary wave dispersion law greatly reduce the large coefficient of nonlinearity. Thus, a search for wave turbulence in a large drop of fluid that is positioned in a microgravity experiment was conducted. Capillary waves that run around the surface of the drop are excited, and their power spectrum and higher order correlations are analyzed for wave turbulence. The theoretical calculations indicate that modulations of the power spectrum should propagate as second sound waves. These issues have consequences for signal processing and plasma confinement. Author

N91-21356*# Battelle Inst., Frankfurt am Main (Germany, F.R.).
DROP EVAPORATION IN A SINGLE-AXIS ACOUSTIC LEVITATOR
E. G. Lierke and A. P. Croonquist (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) *In* JPL, Proceedings of the First Workshop on Containerless Experimentation in Microgravity 1 May 1990 p 308-31 (For primary document see N91-21331 13-29)
Avail: NTIS HC/MF A24 CSCL 22A

A 20 kHz single-axis acoustic positioner is used to levitate aqueous-solution drops (volumes less than or approximately equal to 100 micro-liters). Drop evaporation rates are measured under ambient, isothermal conditions for different relative humidities. Acoustic convection around the levitated sample enhances the mass loss over that due to natural convection and diffusion. A theoretical treatment of the mass flow is developed in analogy to previous studies of the heat transfer from a sphere in an acoustic field. Predictions of the enhanced mass loss, in the form of Nusselt (Sherwood) numbers, are compared with observed rages of drop shrinking. The work is part of an ESA crystal growth from levitated solution drops. Author

N91-21357*# Yale Univ., New Haven, CT. Dept. of Mechanical Engineering.
RHEOLOGICAL PROPERTIES, SHAPE OSCILLATIONS, AND COALESCENCE OF LIQUID DROPS WITH SURFACTANTS
R. E. Apfel and R. G. Holt *In* JPL, Proceedings of the First Workshop on Containerless Experimentation in Microgravity 1 May 1990 p 320-32 (For primary document see N91-21331 13-29)
Avail: NTIS HC/MF A24 CSCL 22A

A method was developed to deduce dynamic interfacial properties of liquid drops. The method involves measuring the frequency and damping of free quadrupole oscillations of an acoustically levitated drop. Experimental results from pure liquid-liquid systems agree well with theoretical predictions. Additionally, the effects of surfactants is considered. Extension of these results to a proposed microgravity experiment on the drop physics module (DPM) in USML-1 are discussed. Efforts are also underway to model the time history of the thickness of the fluid layer between two pre-coalescence drops, and to measure the film thickness experimentally. Preliminary results will be reported, along with plans for coalescence experiments proposed for USML-1. Author

N91-21358*# Washington State Univ., Pullman. Dept. of Physics.
OPTICAL SCATTERING METHODS APPLICABLE TO DROPS AND BUBBLES
Philip L. Marston *In* JPL, Proceedings of the First Workshop on Containerless Experimentation in Microgravity 1 May 1990 p 326-33 Sponsored in part by ONR (For primary document see N91-21331 13-29)
Avail: NTIS HC/MF A24 CSCL 22A

An overview of optical scattering properties of drops and bubbles is presented. The properties lead to unconventional methods for optically monitoring the size or shape of a scatterer and are applicable to acoustically levitated objects. Several of the methods are applicable to the detection and measurement of small amplitude oscillations. Relevant optical phenomena include: (1) rainbows; (2) diffraction catastrophes from spheroids; (3) critical angle scattering; (4) effects of coatings; (5) glory scattering; and (6) optical levitation. Author

N91-21359*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
UNDERCOOLING OF ACOUSTICALLY LEVITATED MOLTEN DROPS
K. Ohsaka, E. H. Trinh, and M. E. Glicksman (Rensselaer Polytechnic Inst., Troy, NY.) *In its* Proceedings of the First Workshop on Containerless Experimentation in Microgravity 1 May 1990 p 335-343 (For primary document see N91-21331 13-29)
Avail: NTIS HC/MF A24 CSCL 22A

It was observed that the acoustically levitated molten SCN (succinonitrile) drops can generally be undercooled to a degree where the impurities in the drop are responsible for the nucleation of the solid phase. However, it was also observed that ultrasound occasionally terminates undercooling of the levitated drops by initiating the nucleation of the solid at an undercooling level which is lower than that found for the nucleation catalyzed by the impurities in the drop. This premature nucleation can be explained by thermodynamic considerations which predict an increase in effective undercooling of the liquid upon the collapse of cavities. Pre-existing gas microbubbles which grow under the influence of ultrasound are suggested as the source of cavitation. The highly undercooled SCN drops can be utilized to measure the growth velocity of the solid in the deeply undercooled region including the hypercooled region. Author

N91-21360*# California Univ., Los Angeles. Dept. of Materials Science and Engineering.
CONTAINERLESS SYNTHESIS OF CERAMIC MATERIALS USING MICROWAVE HEATING
B. Dunn and S. Crouch-Baker *In* JPL, Proceedings of the First Workshop on Containerless Experimentation in Microgravity 1 May 1990 p 347-35 (For primary document see N91-21331 13-29)
Avail: NTIS HC/MF A24 CSCL 22A

It was demonstrated that microwave heating technique may be employed for the synthesis of a number of multicomponent ceramic oxide-based materials, e.g., YBa2Cu3O7 and CuFe2O4. A characteristic, and potentially extremely useful, feature of such synthesis is that they occur in significantly less time than that required using conventional furnace-based techniques. However, the information obtained to date is necessarily rather empirical, and systematic investigations of the use of microwave heating for the synthesis of ceramic materials are required. The synthesis of

ceramic materials at high temperatures are often affected by unwanted, deleterious reactions of the reactants and/or products with the reaction container. Consequently, it is of interest to investigate the high temperature synthesis of ceramic materials using microwave heating in a containerless environment. Author

N91-21361*# National Inst. of Standards and Technology, Gaithersburg, MD. Thermophysics Div.
A HIGH-SPEED SPATIAL (LINEAR) SCANNING PYROMETER: A TOOL FOR DIAGNOSTICS, TEMPERATURE MAPPING, AND PROPERTY DETERMINATIONS AT HIGH TEMPERATURES
A. Cezairliyan, R. F. Chang, and G. M. Foley *In* JPL, Proceedings of the First Workshop on Containerless Experimentation in Microgravity 1 May 1990 p 352-35 (For primary document see N91-21331 13-29)
Avail: NTIS HC/MF A24 CSCL 22A

Development of a fast spatial scanning pyrometer for temperature measurements above 1500 K is described. The salient features of the pyrometer are: (1) it measures spectral radiance temperature (at 0.65 micron) at 1024 points along a straight line (25 mm long) on the target; (2) it has no moving parts and uses a self-scanning linear array of silicon photodiodes as the detector; (3) its output is recorded digitally every 1 microsec with a full-scale resolution of about 1 part in 4000, permitting performance of a complete cycle of measurements (1024 points) in about 1 ms. Operational characteristics of the pyrometer are given. Examples of measurements of the temperature along rapidly heated (resistive self-heating) specimens (rod, tube, strip) are presented. Potential use of the pyrometer in the experiments, both ground-based and in microgravity, requiring temperature mapping and property distribution of the specimen at high temperatures is discussed. Author

N91-21362*# Casting Analysis Corp., Weyers Cave, VA.
MULTIPLE SENSOR MULTIFREQUENCY EDDY CURRENT MONITOR FOR SOLIDIFICATION AND GROWTH
John Wallace *In* JPL, Proceedings of the First Workshop on Containerless Experimentation in Microgravity 1 May 1990 p 357-36 (For primary document see N91-21331 13-29)
Avail: NTIS HC/MF A24 CSCL 22A

A compact cylindrical multisensor eddy current measuring system with integral furnace was develop to monitor II-VI crystal growth to provide interfacial information, solutal segregation, and conductivities of the growth materials. The use of an array of sensors surrounding the furnace element allows one to monitor the volume of interest. Coupling these data with inverse multifrequency analysis allows radial conductivity profiles to be generated at each sensor position. These outputs were incorporated to control the processes within the melt volume. The standard eddy current system functions with materials whose electric conductivities are as low as 2E2 Mhos/m. A need was seen to extend the measurement range to poorly conducting media so the unit was modified to allow measurement of materials conductivities 4 order of magnitude lower and bulk dielectric properties. Typically these included submicron thick films and semiinsulating GaAs. This system was used to monitor complex heat transfer in grey bodies as well as semiconductor and metallic solidification. Author

N91-21363*# Oak Ridge National Lab., TN. Instrumental and Controls Div.
HIGH-TEMPERATURE METAL PURIFICATION USING A COMPACT, PORTABLE rf HEATING AND LEVITATION SYSTEM ON THE WAKE SHIELD
C. A. Hahs *In* JPL, Proceedings of the First Workshop on Containerless Experimentation in Microgravity 1 May 1990 p 366-37 (For primary document see N91-21331 13-29)
(Contract DE-AC05-84OR-21400)
Avail: NTIS HC/MF A24 CSCL 22A

The potential use of a compact, battery-operated rf levitator and heating system to purify high-temperature melting materials in space is described. The wake shield now being fabricated for the Space Vacuum Epitaxy Center will provide an Ultra-high vacuum (10(exp -14) Torr hydrogen, 10(exp -14) Torr helium, 10(exp -30) Torr oxygen). The use of the wake shield to purify Nb, Ti, W, Ir, and other metals to a purity level not achievable on earth is described. Author

N91-21364*# Oak Ridge National Lab., TN.
COMPACT rf HEATING AND LEVITATION SYSTEMS FOR THE NASA MODULAR ELECTROMAGNETIC LEVITATOR
R. J. Fox *In* JPL, Proceedings of the First Workshop on Containerless Experimentation in Microgravity 1 May 1990 p 372-37 (For primary document see N91-21331 13-29)
(Contract DE-AC05-84OR-21400)
Avail: NTIS HC/MF A24 CSCL 22A

The levitator demonstrates levitation of a 5 mm diam aluminum sphere at 1 G using a small, compact rf levitator operating from a small 12-V battery. This system is designed to levitate and melt niobium in space; however, the small battery unit limits the power for melting operations. Author

N91-21365*# Oak Ridge National Lab., TN.
HIGH TEMPERATURE METAL PURIFICATION USING A COMPACT PORTABLE rf HEATING AND LEVITATION SYSTEM ON THE WAKE SHIELD Abstract Only
C. A. Hahs *In* JPL, Proceedings of the First Workshop on Containerless Experimentation in Microgravity 1 May 1990 p 378 (For primary document see N91-21331 13-29)
Avail: NTIS HC/MF A24 CSCL 22A

The Wake Shield Facility (WSF) can provide an ideal vacuum environment for the purification of high temperature metals in space. The Modular Electromagnetic Levitator (MEL), will provide the opportunity to study undercooling of metals in space and allow to determine material properties in space. The battery powered rf levitation and heating system developed for the MEL demonstrated efficiency of 36 percent. This system is being considered to purify metals at temperatures below 3000 C. Author

N91-21366*# Intersonics, Inc., Northbrook, IL.
OPTICAL PROPERTY MEASUREMENTS AS A DIAGNOSTIC TOOL FOR CONTROL OF MATERIALS PROCESSING IN SPACE AND ON EARTH
Shankar Krishnan, J. K. Richard Weber, Paul C. Nordine, and Robert A. Schiffman *In* JPL, Proceedings of the First Workshop on Containerless Experimentation in Microgravity 1 May 1990 p 379-38 (For primary document see N91-21331 13-29)
Avail: NTIS HC/MF A24 CSCL 22A

A new method is described, including results, to measure, control, and follow containerless processing in ground based levitators. This technique enables instantaneous optical property measurements from a transient solid or liquid surface concurrent with true temperature measurement. This was used successfully as a diagnostic tool to follow processing of Al, Si, and Ti during electromagnetic levitation. Experiments on Al show the disappearance of the oxide (emittance 0.33) at ca. 1300 C leaving a liquid surface with an emittance of 0.06. Electromagnetic levitation of silicon shows a liquid with a constant emittance (0.2) but with a solid whose emittance decreases very rapidly with increasing temperature. Consequently, the processing of materials at high temperatures can be controlled quite well through the control of surface optical properties. Y.S.

N91-21367*# Intersonics, Inc., Northbrook, IL.
CONTAINERLESS PROCESSING OF AMORPHOUS CERAMICS
J. K. Richard Weber, Shankar Krishnan, Robert A. Schiffman, and Paul C. Nordine *In* JPL, Proceedings of the First Workshop on Containerless Experimentation in Microgravity 1 May 1990 p 385-39 Sponsored in part by NASA, Washington, DC (For primary document see N91-21331 13-29)
Avail: NTIS HC/MF A24 CSCL 22A

The absence of gravity allows containerless processing of materials which could not otherwise be processed. High melting point, hard materials such as borides, nitrides, and refractory metals are usually brittle in their crystalline form. The absence of dislocations in amorphous materials frequently endows them with

flexibility and toughness. Systematic studies of the properties of many amorphous materials have not been carried out. The requirements for their production is that they can be processed in a controlled way without container interaction. Containerless processing in microgravity could permit the control necessary to produce amorphous forms of hard materials. Author

N91-21368*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
HIGH TEMPERATURE ACOUSTIC AND HYBRID MICROWAVE/ACOUSTIC LEVITATORS FOR MATERIALS PROCESSING Progress Report
Martin Barmatz *In its* Proceedings of the First Workshop on Containerless Experimentation in Microgravity 1 May 1990 p 391-406 (For primary document see N91-21331 13-29)
Avail: NTIS HC/MF A24 CSCL 22A

The physical acoustics group at the Jet Propulsion Laboratory developed a single mode acoustic levitator technique for advanced containerless materials processing. The technique was successfully demonstrated in ground based studies to temperatures of about 1000 C in a uniform temperature furnace environment and to temperatures of about 1500 C using laser beams to locally heat the sample. Researchers are evaluating microwaves as a more efficient means than lasers for locally heating a positioned sample. Recent tests of a prototype single mode hybrid microwave/acoustic levitator successfully demonstrated the feasibility of using microwave power as a heating source. The potential advantages of combining acoustic positioning forces and microwave heating for containerless processing investigations are presented in outline form. Author

N91-21369*# Battelle Inst., Frankfurt am Main (Germany, F.R.).
A NEW, SIMPLE ELECTROSTATIC-ACOUSTIC HYBRID LEVITATOR
E. G. Lierke, H. Loeb, and D. Gross *In* JPL, Proceedings of the First Workshop on Containerless Experimentation in Microgravity 1 May 1990 p 407-42 (For primary document see N91-21331 13-29)
Avail: NTIS HC/MF A24 CSCL 22A

Battelle has developed a hybrid levitator by combining the known single-axis acoustic standing wave levitator with a coaxial DC electric field. The resulting Coulomb forces on the charged liquid or solid sample support its weight and, together with the acoustic force, center the sample. Liquid samples with volumes approximately less than 100 micro-liters are deployed from a syringe reservoir into the acoustic pressure node. The sample is charged using a miniature high voltage power supply (approximately less than 20 kV) connected to the syringe needle. As the electric field, generated by a second miniature power supply, is increased, the acoustic intensity is reduced. The combination of both fields allows stable levitation of samples larger than either single technique could position on the ground. Decreasing the acoustic intensity reduces acoustic convection and sample deformation. Neither the electrostatic nor the acoustic field requires sample position sensing or active control. The levitator, now used for static and dynamic fluid physics investigations on the ground, can be easily modified for space operations. Author

N91-21370*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
FEEDBACK CONTROLLED ELECTROSTATIC AND ELECTROMAGNETIC SAMPLE POSITIONERS
Won-Kyu Rhim and D. D. Elleman *In its* Proceedings of the First Workshop on Containerless Experimentation in Microgravity 1 May 1990 p 427-432 (For primary document see N91-21331 13-29)
Avail: NTIS HC/MF A24 CSCL 22A

Four different sample positioners are discussed. The four systems share a common operating principle in that the sample positioning is achieved by feedback controlled forces which can be electrostatic, dielectrophoretic, or electromagnetic. The first system is the electrostatic liquid drop positioner which operates at the near ambient position. The second system is the tetrahedral electrostatic positioner which is being developed for the high temperature materials processing in vacuum. The third system is essentially the the same tetrahedral system above except that the position control is achieved by dielectrophoretic forces in the pressurized gas environment. Finally, the feasibility of a feedback controlled electromagnetic positioner is discussed. Author

N91-21371*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
A COMPUTER MODEL OF THE ELECTROSTATIC POSITIONING SYSTEM
G. M. Gutt *In its* Proceedings of the First Workshop on Containerless Experimentation in Microgravity 1 May 1990 p 433-437 (For primary document see N91-21331 13-29)
Avail: NTIS HC/MF A24 CSCL 22A

Positioning systems based upon electrstatic forces are being developed for the containerless processing of materials that cannot use acoustic or electromagnetic positioning techniques. Currently, electrode configurations for these electrostatic systems are designed on the basis of approximate analytical calculations and past experience. A three dimensional computer model is being developed that will predict the electrostatic fields and forces for a given electrode configuration and will allow for a more rapid evaluation of proposed designs. Early results of this model are presented. Author

N91-21372*# Intersonics, Inc., Northbrook, IL.
SOME CONSIDERATIONS FOR VARIOUS POSITIONING SYSTEMS AND THEIR SCIENCE CAPABILITIES
Charles A. Rey, D. R. Merkley, and T. J. Danley *In* JPL, Proceedings of the First Workshop on Containerless Experimentation in Microgravity 1 May 1990 p 438-44 Sponsored by NASA, Marshall Space Flight Center (For primary document see N91-21331 13-29)
Avail: NTIS HC/MF A24 CSCL 22A

Containerless processing of materials at elevated temperatures is discussed with emphasis on high temperature chemistry, thermophysical properties, materials science, and materials processing. Acoustic and electromagnetic positioning of high temperature melts are discussed. Results from recent ground based experiments, including KC-135 testing of an acoustic levitator, are presented. Some current positioning technologies and the potential for enhancing them are considered. Further, a summary of these technologies and their science capabilities for the development of future experiments is given. Author

N91-21373*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
RADIOGRAPHIC INSTRUMENTATION FOR DPM EXPERIMENTS
Archie L. Fripp, W. J. Debnam, Richard T. Simchick, and P. G. Barber (Longwood Coll., Farmville, VA.) *In* JPL, Proceedings of the First Workshop on Containerless Experimentation in Microgravity 1 May 1990 p 445-45 (For primary document see N91-21331 13-29)
Avail: NTIS HC/MF A24 CSCL 22A

New developments in x-ray radiography that may be applicable to containerless experimentation are presented. The two features discussed are the use of radiography to determine the position and shape of the solid-liquid interface and, with the aid of appropriate markers, the flow patterns in either the surface or bulk of the liquid state. Both surface energy and fluid viscosity measurements can be made with the aid of the described radiographic system. Author

N91-21374*# Vanderbilt Univ., Nashville, TN.
THE METROLOGY OF SPHERICAL SHELLS USING SYNCHROTRON X RAY MICROTOMOGRAPHY
Anthony B. Hmelo, James L. Allen, and Kevin L. DAmico (Exxon Research and Engineering Co., Linden, NJ.) *In* JPL, Proceedings of the First Workshop on Containerless Experimentation in Microgravity 1 May 1990 p 455-45 (For primary document

see N91-21331 13-29)
Avail: NTIS HC/MF A24 CSCL 22A

With recent advances in solid state imaging technology and the increasing availability of synchrotron x-ray radiation sources, synchrotron x-ray microtomography is emerging as a nondestructive technique for the evaluation of the structure and composition of small specimens with spatial resolution in the micron range. Synchrotron radiation offers the following advantages over conventional x-ray sources: high brightness, continuous emission which is tunable over a large energy range, faster data collection rates, and a highly collimated beam of large cross section permitting the illumination of large specimens. Synchrotron x-ray microtomography enables the structure of individual spheres to be evaluated in order to reveal the concentricity and sphericity of the internal void and the uniformity of the shell wall in the case of high quality spherical shells for Sandia National Laboratories' Inertial Confinement Fusion project. Author

N91-21375*# Vanderbilt Univ., Nashville, TN.
DROP COALESCENCE STUDIES
A. V. Anikumar and T. G. Wang *In* JPL, Proceedings of the First Workshop on Containerless Experimentation in Microgravity 1 May 1990 p 459-46 (For primary document see N91-21331 13-29)
Avail: NTIS HC/MF A24 CSCL 22A

The objective of this experimental study is to understand the detailed mechanics of the coalescence of liquid drops. The experiments are being conducted in an immiscible acoustic levitator with degassed water as the host medium. Typically, a quasineutrally buoyant drop of silicon oil mixed with bromobenzene is levitated close to the velocity node of the levitator. A second drop of the same liquid is introduced, and as it slowly seeks levitation position, the drops coalesce. Coalescence is delayed until the host film between drops is completely drained. Following coalescence, the excess surface energy in the coalesced drop is dissipated through shape oscillations. The final events of film rupture followed by drop coalescence are rapid and are photographically studied with high-speed video (1000 fps). The laser-induced fluorescence technique is used to visualize the dynamics of host film drainage. The details of the coalescence mechanics are presented.
Author

N91-21376*# California Univ., Los Angeles. Dept. of Physics.
OSCILLATIONAL INSTABILITIES IN SINGLE MODE ACOUSTICS LEVITATORS
J. Rudnick and Martin Barmatz (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) *In* JPL, Proceedings of the First Workshop on Containerless Experimentation in Microgravity 1 May 1990 p 465-47 (For primary document see N91-21331 13-29)
Avail: NTIS HC/MF A24 CSCL 22A

An extention of standard results for the acoustic force on an object in a single-mode resonant chamber yields predictions for the onset of oscillational instabilities when objects are levitated or positioned in these chambers. The authors' results are consistent with those of experimental investigators. The present approach accounts for the effects of time delays in the response of a cavity to the motion of an object inside of it. Quantitative features of the instabilities are investigated. The experimental conditions required for sample stability, saturation of sample oscillations, hysteretic effects, and the loss of ability to levitate are discussed. Author

N91-21377*# Rice Univ., Houston, TX. Dept. of Mechanical Engineering and Materials Science.
A HIGH TEMPERATURE THERMAL DIFFUSIVITY DETERMINATION PROCEDURE FOR SOLIDS AND LIQUIDS Abstract Only
Yildiz Bayazitoglu, P. V. R. Suryanarayana, and Udaya B. Sathuvalli *In* JPL, Proceedings of the First Workshop on Containerless Experimentation in Microgravity 1 May 1990 p 479 (For primary document see N91-21331 13-29)
Avail: NTIS HC/MF A24 CSCL 22A

A new method for measuring the thermal diffusivity of materials at high temperatures is presented. The method is applicable to solids on Earth, and to liquids in the reduced gravity environment of space. It is especially suited to levitated liquid metals at elevated temperatures where thermal diffusivity data is not available. The method is applied in two parts, such that lumped analysis is valid in the first part, and Fourier's law of conduction is valid in the second. In both parts, the spherical specimen is assumed to have been heated to a desired temperature and cooled. An inverse conduction problem is then formulated and solved using Laplace transformation techniques. Using this solution, sample sizes, and experimentally obtained surface temperature history, the thermal diffusivity is determined by minimizing a function that satisifies the heat balance at the surface. Minimization is performed using a modified quasilinearization algorithm. Accuracy is very sensitive to error in the temperature data and increases with better curve fits to the temperature data. An error analysis is also performed, and the effect of errors in the various parameters on the evaluated thermal diffusivity is determined. An experimental study for solids on Earth is suggested, before development for implementation in space. Author

N91-21378*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
AN EXAMINATION OF ANTICIPATED g-JITTER ON SPACE STATION AND ITS EFFECTS ON MATERIALS PROCESSES
Emily S. Nelson Apr. 1991 118 p
(NASA-TM-103775; E-6042; NAS 1.15:103775) Avail: NTIS HC/MF A06 CSCL 22A

Discussed here are the effects of g-jitter, the residual acceleration aboard spacecraft, on selected cases of materials processes. In particular, the anticipated acceleration environment aboard Space Station Freedom and its potential effects are analyzed. The topic is covered with a sufficient level of generosity as to apply to other processes and vehicles as well. Key findings of the study are discussed. Author

N91-21165# Center for Industrial Research, Oslo (Norway).
ZEOLITES IN SPACE
Arnfinn G. Andersen and Michael Stoecher *In* Norwegian Space Center, From Earth to Space and Back: Selected Papers on Norwegian Space Activities Mar. 1990 p 31-32 (For primary document see N91-21159 13-12)
Avail: NTIS HC/MF A04

31 ENGINEERING (GENERAL)

Includes vacuum technology; control engineering; display engineering; cryogenics; and fire prevention.

N91-21379# National Aerospace Lab., Tokyo (Japan).
PROCEEDINGS OF THE 8TH NAL SYMPOSIUM ON AIRCRAFT COMPUTATIONAL AERODYNAMICS: PROSPECTS OF COMPUTATIONAL FLUID DYNAMICS AND SUPER COMPUTERS IN AEROSPACE SCIENCE AND TECHNOLOGY
Sep. 1990 118 p In ENGLISH and JAPANESE Symposium held in Tokyo, Japan, 25-27 Jun. 1990
(NAL-SP-13; ISSN-0289-260X) Avail: NTIS HC/MF A06

The papers presented at the symposium are given. Some representative titles are as follows: Computer requirements for further CFD development; Present and future of CFD on the Aero-Engine development in IHI; CFD research and systems in Kawasaki Heavy Industries and its future prospects; The CFD analysis related aerospace in Fuji Heavy Industries, Ltd.; and Parallelization techniques for a supercomputer with Hierarchical Memory Architecture. For individual titles, see N91-21380 through N91-21388.

N91-21380# National Aerospace Lab., Tokyo (Japan).
COMPUTER REQUIREMENTS FOR FURTHER CFD DEVELOPMENT **c34**
Hajime Miyoshi *In its* Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics: Prospects of

Computational Fluid Dynamics and Super Computers in Aerospace Science and Technology Sep. 1990 p 1-26 In JAPANESE; ENGLISH summary (For primary document see N91-21379 13-31)
Avail: NTIS HC/MF A06

It is well known that the rapid development in computational fluid dynamics (CFD) has followed the development of powerful computers. The same situation is also recognized at NAL. The requirements are given for computer power (processing speed and main memory capacity) that is necessary for the CFD to play important roles in the future R and D of aerospace planes and innovative aircraft, and it is pointed out that today's supercomputer architectures are not likely to attain the processing speed required and that more parallelism should be developed. Finally, several important items are discussed in designing the target computer: bipolar technology based processing element vs. MOS technology based processing element; shared memory vs. distributed memory; interconnection network's topology; software technologies' cost and running cost of the target computer, etc. Author

N91-21381# Ishikawajima-Harima Heavy Industries Co. Ltd., Tokyo (Japan).
PRESENT AND FUTURE OF CFD ON THE AERO-ENGINE DEVELOPMENT IN IHI **c34**
Atsushige Tanaka *In* National Aerospace Lab., Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics: Prospects of Computational Fluid Dynamics and Super Computers in Aerospace Science and Technology Sep. 1990 p 27-46 In JAPANESE; ENGLISH summary (For primary document see N91-21379 13-31)
Avail: NTIS HC/MF A06

Advances in aircraft engine performance and economy are achieved by a fusion of many individual advances in technology. Especially striking advances in the evolution of aerodynamic technology have appeared in the development and utilization of computational fluid dynamics (CFD). CFD already may have attained the level and continues to demonstrate extraordinarily valuable possibilities, in which it is an essential complement to testing and experimentation. A brief review is presented of the current status and the future of CFD on aircraft engine development in IHI. Author

N91-21382# Kawasaki Heavy Industries Ltd., Gifu (Japan). Aircraft Research Lab.
CFD RESEARCH AND SYSTEMS IN KAWASAKI HEAVY INDUSTRIES AND ITS FUTURE PROSPECTS **c34**
Koichi Hiraoka *In* National Aerospace Lab., Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics: Prospects of Computational Fluid Dynamics and Super Computers in Aerospace Science and Technology Sep. 1990 p 47-55 In JAPANESE; ENGLISH summary (For primary document see N91-21379 13-31)
Avail: NTIS HC/MF A06

KHI Computational Fluid Dynamics (CFD) system is composed of VP100 computer and 2-D and 3-D Euler and/or Navier-Stokes (NS) analysis softwares. For KHI, this system has become a very powerful aerodynamic tool together with the Kawasaki 1 m Transonic Wind Tunnel. The 2-D Euler/NS software, developed in-house, is fully automated, requires no special skill, and was successfully applied to the design of YXX high lift devices and SST supersonic inlet, etc. The 3-D Euler/NS software, developed under joint research with NAL, has an interactively operated Multi-Block type grid generator and can effectively generate grids around complex airplane shapes. Due to the main memory size limitation, 3-D analysis of relatively simple shape, such as SST wing-body, was computed in-house on VP100, otherwise, such as detailed 3-D analyses of ASUKA and HOPE, were computed on NAL VP400, which is 10 times more powerful than VP100, under KHI-NAL joint research. These analysis results have very good correlation with experimental results. However, the present CFD system is less productive than wind tunnel and has applicability limitations. Author

N91-21383# Fuji Heavy Industries Ltd., Utsunomiya (Japan).
THE CFD ANALYSIS RELATED AEROSPACE IN FUJI HEAVY INDUSTRIES, LTD. **c34**
Kohei Tanaka, Hidehiro Hirose, and Yasuhiro Koshioka *In* National Aerospace Lab., Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics: Prospects of Computational Fluid Dynamics and Super Computers in Aerospace Science and Technology Sep. 1990 p 57-67 In JAPANESE; ENGLISH summary (For primary document see N91-21379 13-31)
Avail: NTIS HC/MF A06

The relationships of Computational Fluid Dynamics (CFD) with design processes are discussed. CFD activities in FHI, Ltd. are introduced. To obtain full merit of CFD in design, the interactive manner of use is very important. Much more high computing speed is needed, also, more flexible in-out systems, too. In FHI, 2D/3D Euler, 2D/3D N-S codes were developed and in operation for several years. Also, many codes of panel method, potential method, and Newtonian flow method, are in use. These CFD tools are very effective in design. FHI is still making efforts to get more refined and quicker systems. CFD is very high technology, so efforts from aircraft makers have some limitations. Author

N91-21384# Mitsubishi Heavy-Industries Ltd., Nagoya (Japan). Engineering Research Dept.
STATUS AND OUTLOOK OF CFD TECHNOLOGY AT MITSUBISHI HEAVY INDUSTRIES, NAGOYA **c34**
Tadayuki Tanioka *In* National Aerospace Lab., Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics: Prospects of Computational Fluid Dynamics and Super Computers in Aerospace Science and Technology Sep. 1990 p 69-81 In JAPANESE; ENGLISH summary (For primary document see N91-21379 13-31)
Avail: NTIS HC/MF A06

Computational Fluid Dynamics (CFD) technology has made tremendous progress in the last several years. It has matured to become a practical simulation tool in aircraft industries. In MHI, CFD has become an indispensible tool for aerodynamic design aerospace vehicles. The present status is described of this advanced technology at MHI. Also mentioned are some future advances of the fast growing technology as well as associated hardware requirements. Author

N91-21385# National Aerospace Lab., Tokyo (Japan).
CFD DEVELOPMENT PRESENT AND PROSPECTS AT NAL **c34**
Naoki Hirose and Koji Isogai *In its* Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics: Prospects of Computational Fluid Dynamics and Super Computers in Aerospace Science and Technology Sep. 1990 p 83-92 In JAPANESE; ENGLISH summary (For primary document see N91-21379 13-31)
Avail: NTIS HC/MF A06

A brief review of CFD development efforts in the past and present are described and various issues which are important in further development of CFD are given. They are development of super powered parallel processor for CFD, more accurate models for turbulence in compressible flows and chemical reactions in combustion burners and hypersonic flow, scheme for vortical flows, grid generation techniques, and CFD code validation. Code validation efforts in Anglo-European countries are referred. Author

N91-21386# Nippon Electric Co. Ltd., Tokyo (Japan).
PARALLELIZATION TECHNIQUES FOR A SUPERCOMPUTER WITH HIERARCHICAL MEMORY ARCHITECTURE **c62**
Noriyuki Ando and Naoki Nishi *In* National Aerospace Lab., Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics: Prospects of Computational Fluid Dynamics and Super Computers in Aerospace Science and Technology Sep. 1990 p 93-97 In JAPANESE; ENGLISH summary (For primary document see N91-21379 13-31)
Avail: NTIS HC/MF A06

Large numerical simulation needs a multiprocessor

supercomputer, but in tightly coupled architecture, memory access contention degrades performance. This contention can be reduced by each processor having its own local memory. Hierarchical common local memory architecture is evaluated, and its programming techniques are described. Author

N91-21387# Hitachi Ltd., Tokyo (Japan).
CFD SIMULATION ON A MASSIVELY PARALLEL PROCESSOR **c34**
Teruo Tanaka and Koichiro Omoda *In* National Aerospace Lab., Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics: Prospects of Computational Fluid Dynamics and Super Computers in Aerospace Science and Technology Sep. 1990 p 99-108 In JAPANESE; ENGLISH summary (For primary document see N91-21379 13-31)
Avail: NTIS HC/MF A06

A new array data assignment technique, to be used in CFD (computational fluid dynamics) simulations on massively parallel processor is presented. The implementation was done for an H2P parallel processor. H2P is an MIMD (Multiple Instructions Multiple Data stream) type of parallel processor in which every processing element (PE) has a local memory (i.e., a distributed memory parallel processor) and a vector facility. An original data assignment technique is proposed which leads to an efficient use of the vector facility. The proposed data assignment technique uses a combination of two methods (SWAP and Wave Front) in order to achieve its purpose, an efficient use of the vector facility. The original CFD program is modified into a parallelized one, by applying the proposed methods. It is shown that, in running this modified program, H2P can achieve a 180 times speedup over the original CFD program running on a uniprocessor (using the same type of PE). Author

N91-21388# Fujitsu Ltd., Tokyo (Japan).
THE SOFTWARE SYSTEM ON PARALLEL PROCESSOR FOR COMPUTATIONAL FLUID DYNAMICS **c61**
Shin Okada and Moriyuki Takamura *In* National Aerospace Lab., Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics: Prospects of Computational Fluid Dynamics and Super Computers in Aerospace Science and Technology Sep. 1990 p 109-116 In JAPANESE; ENGLISH summary (For primary document see N91-21379 13-31)
Avail: NTIS HC/MF A06

A preliminary study on the software system for a parallel processor with a distributed memory is described. One of the reasons for the difficulty in parallel programmings on the distributed memory parallel processors lies in requirement such that both the procedures and array data be allocated on the same processor. Considering the CFD program characteristics, a fundamental function is presented of the FORTRAN compiler and the operating system, which cover a logical global memory, procedure and data allocation onto a processor, and parallel execution scheme. Also proposed is the users responsibility in writing parallel programs. Author

N91-21389# Tecogen, Inc., Waltham, MA.
DEVELOPMENT OF A GAS ENGINE-DRIVEN CHILLER Final Report, May 1985 - Nov. 1988
R. Panora, M. Koplow, J. Gehret, and J. Morgan May 1990 345 p
(Contract GRI-5084-293-1135)
(PB91-130237; TR7020-041-90; GRI-90/0039) Avail: NTIS HC/MF A15 CSCL 13I

A development of a natural gas engine-driven chiller with a nominal capacity of 150 tons and an optional engine and exhaust waste-heat recovery system totaling approximately 700,000 Btu/hr is described. The design is based on a conventional vapor-compression cycle, which uses an oil-flooded twin-screw compressor. Three program phases are presented: (1) initial development of the product and assessment of its market viability; (2) final laboratory development and field experiment of an early prototype; and (3) a nationwide field test of 7 production prototypes. The reliability and serviceability of the chiller have met expectations and have proven to be within the bounds of acceptability for this type of equipment. Author

N91-21390 ESDU International Ltd., London (England).
PROCESS INTEGRATION: PROCESS CHANGE AND BATCH PROCESSES
Dec. 1990 89 p
(ESDU-90033; ISBN-0-85679-759-6; ISSN-0141-402X) Avail: ESDU

The application of process integration to batch processes and other time-dependent systems (for example, the start-up of a continuous process, a multi-plant complete site, or even a building) is investigated. Methods are described for determining energy targets, for identifying possibilities for heat storage (within or between the batches) and for rescheduling process operations to minimize heat exchange, and for designing heat recovery networks. In addition, consideration is given to the use of process changes in continuous systems that will reduce energy targets (for example, changing a distillator column temperature, adding a pumparound or intermediate boiler, or changing the number of stages in an evaporator). The techniques described are developed and explained through case studies that illustrate their practical application. Author

N91-21391# Sandia National Labs., Albuquerque, NM.
HOW CLEAN IS CLEAN. HOW CLEAN IS NEEDED
A. K. Hays 1991 10 p Presented at the Environmentally Conscious Manufacturing/Technology Applications Workshop, Albuquerque, 20 Feb. 1991
(Contract DE-AC04-76DP-00789)
(DE91-008173; SAND-91-0420C; CONF-910279-6) Avail: NTIS HC/MF A02

This paper will provide an overview of cleaning qualifications used in a variety of industries: from small-scale manufacturer's of precision-machined products to large-scale manufacturer's of electronics (printed wiring boards and surface mount technology) and microelectronics. Cleanliness testing techniques used in the production of precision-machined products, will be described. The on-going DOD program to obtain high-reliability electronics, through the use of military specifications for cleaning and cleanliness levels, will be reviewed. In addition, the continually changing cleanroom/materials standards of the microelectronics industry will be discussed. Finally, we will speculate on the role that new and improved analytical techniques and sensor technologies will play in the factories of the future. DOE

N91-21392# MMR Technologies, Inc., Mountain View, CA.
DEVELOPMENT OF A LOW NOISE 10 KJ-T REFRIGERATION SYSTEM Technical Progress Report, 15 Oct. - 31 Dec. 1990
Robert L. Paugh 5 Jan. 1991 5 p
(Contract N00014-86-C-0301)
(AD-A231383) Avail: NTIS HC/MF A01 CSCL 13/1

Work has continued on the evaluation of the pneumatic compressor system which will be used to demonstrate (1) operating lifetime of the refrigerator gas compressor under development and (2) compressor-refrigerator system performance. Work to improve the cooling capacity of the refrigerator at 20 K by using more efficient heat exchanger designs has continued. While operation down to 20 K was achieved and reliably reproduced the investigation of the use of thinner glass slides and metal foils as the interlayer in the heat exchanger suggests that substantial increase in the exchanger efficiency can be achieved. This work is also being utilized to enhance the performance of the heat exchanger section of the third stage of the refrigerator, the helium stage. GRA

N91-21393# MMR Technologies, Inc., Mountain View, CA.
DEVELOPMENT OF A LOW NOISE 10K J-T REFRIGERATION SYSTEM Technical Progress Report, 31 Aug. - 15 Oct. 1990
William A. Little 15 Oct. 1990 5 p
(Contract N00014-86-C-0301)
(AD-A231461) Avail: NTIS HC/MF A01 CSCL 13/1

The development of a low noise, Joule-Thomson, microminiature refrigeration system is summarized. Progress was made on the development of the pneumatic compressor drive system which will be used to operate the compressor to determine the compressor lifetime and refrigerator system performance. Work on the refrigerator itself also has progressed well with operation down to 20 K now being achieved, and reliably reproduced. Work is underway on the heat exchanger section of the third stage of the refrigerator, the helium stage. GRA

32 COMMUNICATIONS AND RADAR

Includes radar; land and global communications; communications theory; and optical communications.

For related information see also *04 Aircraft Communications and Navigation* and *17 Space Communications, Spacecraft Communications, Command and Tracking.* For search and rescue see *03 Air Transportation and Safety,* and *16 Space Transportation.*

N91-21394*# Ohio State Univ., Columbus. ElectroScience Lab.
A SYSTEM FOR THE REAL-TIME DISPLAY OF RADAR AND VIDEO IMAGES OF TARGETS
W. W. Allen and W. D. Burnside Aug. 1990 155 p Sponsored by Pacific Missile Test Center, Point Mugu, CA
(Grant NAG2-542)
(NASA-CR-188058; NAS 1.26:188058; ESL-TR-722780-1) Avail: NTIS HC/MF A08 CSCL 17I

Described here is a software and hardware system for the real-time display of radar and video images for use in a measurement range. The main purpose is to give the reader a clear idea of the software and hardware design and its functions. This system is designed around a Tektronix XD88-30 graphics workstation, used to display radar images superimposed on video images of the actual target. The system's purpose is to provide a platform for tha analysis and documentation of radar images and their associated targets in a menu-driven, user oriented environment. Author

N91-21395# National Telecommunications and Information Administration, Boulder, CO. Inst. for Telecommunication Sciences.
DESIGN OF EXPERIMENTS TO QUANTIFY COMMUNICATION SATELLITE SYSTEM PERFORMANCE
R. D. Cass and M. J. Miles Nov. 1990 102 p
(PB91-129635; NTIA-90-269) Avail: NTIS HC/MF A06 CSCL 17B

The steps are described for designing experiments to quantify the performance of a communication satellite system according to the methods specified by ANS X3.141. Performance is described in terms of performance parameters that are user oriented and system independent. The design is intended to efficiently obtain estimates of performance parameters that are relatively free of bias and can be stated with known precision. Service, traffic, propagation path, and propagation impairment are the primary factors. Factorial designs are recommended for the experiment. Author

N91-21396# National Telecommunications and Information Administration, Boulder, CO. Inst. for Telecommunication Sciences.
LONG-TERM PERFORMANCE AND PROPAGATION MEASUREMENTS ON SINGLE AND TANDEM DIGITAL MICROWAVE TRANSMISSION LINKS. VOLUME 1: ANALYSIS OF MEASUREMENT DATA
James A. Hoffmeyer and Timothy J. Riley Aug. 1990 166 p Sponsored by Defense Communications Agency, Washington, DC
(PB91-129643; NTIA-90-265-Vol-1) Avail: NTIS HC/MF A08 CSCL 20N

The results of an 18 month digital microwave radio performance and propagation measurement project that was conducted on a portion of the Defense Communications System in Germany are described. More than 6 gigabytes of data were collected between Apr. 1988 and Oct. 1989. The collected data include end-to-end (user-to-user) performance data, radio performance and propagation data on one line-of-sight and one troposcatter link, and meteorological data. The end-to-end measurements are referred to as the Network Performance Characterization (NPC) data, and consist of error performance measurements on two separate 64 kb/s channels consisting of tandem terrestrial microwave links. The radio performance and propagation measurements are referred to as the Link Performance Characterization (LPC) data. The data consists of digital radio performance and propagation measurements made on a long (99 km) line-of-sight microwave link. The propagation measurements on the link include multipath delay spread, in-band power difference (IBPD), and receive signal level (rsl) measurements. Summaries are provided for the long-term statistics of both radio performance and propagation data. GRA

N91-21397# National Telecommunications and Information Administration, Boulder, CO. Inst. for Telecommunication Sciences.
LONG-TERM PERFORMANCE AND PROPAGATION MEASUREMENTS ON SINGLE AND TANDEM DIGITAL MICROWAVE TRANSMISSION LINKS. VOLUME 2: APPENDIXES
James A. Hoffmeyer and Timothy J. Riley Aug. 1990 143 p Sponsored by Defense Communications Agency, Washington, DC
(PB91-129650; NTIA-90-265-Vol-2) Avail: NTIS HC/MF A07 CSCL 20N

The results of an 18 month digital microwave radio performance and propagation measurement project that was conducted on a portion of the Defense Communications System in Germany are described. More than 6 gigabytes of data were collected between Apr. 1988 and Oct. 1989. Summaries are provided of the long-term statistics of both radio performance and propagation data. The performance data are compared with both CITT and Military Standard (MIL-STD) performance criteria. The propagation data are used in the assessment of the causes of digital radio outages. The propagation data are also useful for a variety of modeling purposes. These applications of the propagation data are described. B.G.

N91-21398# National Telecommunications and Information Administration, Boulder, CO. Inst. for Telecommunication Sciences.
EXTENDED DATABASE OF MICROWAVE COMMON CARRIER ANTENNA GAIN PATTERNS
C. Samora and M. A. Province Aug. 1990 511 p Sponsored by National Security Agency/Central Security Service, Fort Meade, MD
(PB91-119206; NTIA-90-267) Avail: NTIS HC/MF A22 CSCL 20N

A collection of microwave common carrier azimuthal antenna patterns is discussed. The patterns were digitized and stored into a uniform formatted data base. The primary application of this data base is for interference prediction among common carrier transmitters sharing a common frequency. The data base can be assessed via a BASIC computer program to determine the gain at any off-axis angle or the plot of the antenna pattern in either rectangular or polar coordinates. Author

N91-21399# Transportation Research Board, Washington, DC.
TRANSPORTATION TELECOMMUNICATIONS Final Report
Philip J. Tarnoff and Ted Pugh (Farradyne Systems, Inc., Rockville, MD.) Oct. 1990 100 p
(Proj. 20-5)
(PB91-123257; TRP/NCHRP/SYN-165; ISBN-0-309-04913-X; ISSN-0547-5570; LC-90-71055) Avail: NTIS HC/MF A05 CSCL 17B

The synthesis series will be of interest to administrators, operating personnel, and others interested in the management and operation of telecommunications systems in transportation agencies. Information is provided on the fundamentals of

telecommunications, types of systems available, current uses in state Departments of Transportation (DOTs), and implementation procedures and alternatives. Most DOTs have telephone and radio systems in use for communications with their own personnel and with the public. Those systems, as well as other telecommunications options that are in use by transportation agencies or are available for their use are described. GRA

N91-21400# Harry Diamond Labs., Adelphi, MD.
THE FAST HARTLEY TRANSFORM Final Report, 1 Nov. 1988 - 30 Jan. 1989
Mark H. Mar Nov. 1990 27 p
(AD-A230370; HDL-TM-90-23) Avail: NTIS HC/MF A03 CSCL 12/5

The purpose of this paper is to report the results of testing the fast Hartley transform (FHT) and comparing it with the fast Fourier transform (FFT). All the definitions and equations in this paper are quoted and cited from the series of references. The author of this report developed a FORTRAN program which computes the Hartley transform. He tested the program with a generalized electromagnetic pulse waveform and verified the results with the known value. Fourier analysis is an essential tool to obtain frequency domain information from transient time domain signals. The FFT is a popular tool to process many of today's audio and electromagnetic signals. System frequency response, digital filtering of signals, and signal power spectrum are the most practical applications of the FFT. However, the Fourier integral transform of the FFT requires computer resources appropriate for the complex arithmetic operations. On the other hand, the FHT can accomplish the same results faster and requires fewer computer resources. The FHT is twice as fast as the FFT, uses only half the computer resources, and so could be more useful than the FFT in typical applications such as spectral analysis, signal processing, and convolution. This paper presents a FORTRAN computer program for the FHT algorithm along with a brief description and compares the results and performance of the FHT and the FFT algorithms. GRA

N91-21401# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
ANALYSIS AND TESTING OF A BISTATIC RADAR CROSS SECTION MEASUREMENT CAPABILITY FOR THE AFIT ANECHOIC CHAMBER M.S. Thesis
Timothy D. McCool Dec. 1990 179 p
(AD-A230609; AFIT/GE/ENG/90D-37) Avail: NTIS HC/MF A09 CSCL 17/9

This research effort examined the feasibility of performing bistatic radar cross section (RCS) measurements in the AFIT anechoic chamber. The capability was established to measure the bistatic RCS of a target versus frequency and versus target azimuth angle. In either case, one of three bistatic angles (angle between transmit and receive antennas) is available: 45, 90, and 135 degrees. Accurate bistatic RCS measurements were obtained using a CW radar and utilizing background subtraction, bistatic calibration, and software range gating. Simple targets were selected for validation purposes since their bistatic RCS could be predicted. These consisted of spheres and flat plates (square, triangle, and five sided). Several computer codes were utilized for system validation. Two codes based on the uniform theory of diffraction were used to predict the scattering from the flat plates. A program using a Mie series solution provided the exact scattering from the flat plates. A program using a Mie series solution provided the exact scattering for the spheres, which were used for both RCS predictions and system calibrations. GRA

N91-21402# Oak Ridge National Lab., TN.
IMPROVING RISK COMMUNICATION THROUGH INTERACTIVE TRAINING IN COMMUNICATION SKILLS
D. A. White (Martin Marietta Energy Systems, Inc., Oak Ridge, TN.) and R. K. White 1991 19 p Presented at the HWHM/HMC-South 1991: Hazardous Waste/Hazardous Materials Conference, Houston, 24-26 Apr. 1991
(Contract DE-AC05-84OR-21400)
(DE91-008366; CONF-9104190-1) Avail: NTIS HC/MF A03

This paper describes a workshop in communication and public speaking skills recently conducted for a group of public officials whose responsibilities include presenting risk information at public meetings associated with hazardous waste sites. We detail the development and execution of the 2(1/2)-day workshop, including the development and integration of a 45-min video of a simulated public meeting used to illustrate examples of good and bad communication behaviors. The workshop uses a mock public meeting video, participatory video exercises, role-playing, an instructor, and a resource text. This interactive approach to teaching communication skills can help sensitize scientists to the public's understanding of risk and improve scientists' confidence and effectiveness in communicating scientific information. DOE

N91-21403*# Houston Univ., Clear Lake, TX. Research Inst. for Computing and Information Systems.
ISSUES IN PROVIDING A RELIABLE MULTICAST FACILITY
Bert J. Dempsey, W. Timothy Strayer, and Alfred C. Weaver Jul. 1990 64 p
(Contract NCC9-16)
(NASA-CR-188089; NAS 1.26:188089) Avail: NTIS HC/MF A04 CSCL 17B

Issues involved in point-to-multipoint communication are presented and the literature for proposed solutions and approaches surveyed. Particular attention is focused on the ideas and implementations that align with the requirements of the environment of interest. The attributes of multicast receiver groups that might lead to useful classifications, what the functionality of a management scheme should be, and how the group management module can be implemented are examined. The services that multicasting facilities can offer are presented, followed by mechanisms within the communications protocol that implements these services. The metrics of interest when evaluating a reliable multicast facility are identified and applied to four transport layer protocols that incorporate reliable multicast. B.G.

N91-21404# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Electromagnetic Wave Propagation Panel.
RADIO WAVE PROPAGATION MODELING, PREDICTION AND ASSESSMENT
Juergen H. Richter, ed. (Naval Ocean Systems Center, San Diego, CA.) 1991 139 p
(AGARD-AG-326; ISBN-92-835-0598-0) Copyright Avail: NTIS HC/MF A07; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

An overview of important topics in radio wave propagation modeling, prediction and assessment is presented. Both propagation in the troposphere and the ionosphere are considered. For tropospheric radio wave propagation major emphasis is given to military systems operating in a marine environment. Various modeling techniques are discussed and operational propagation assessment systems described. Modeling and refractivity sensing of horizontally varying media are identified as topics of high interest. Ionospheric propagation is divided into four areas: long wave, short wave, transionospheric propagation, and scintillation phenomena. Various modeling techniques for long wave propagation and areas which require further attention are discussed. Short wave propagation remains an area of high interest and improvements in propagation assessment can be expected from more complex models and improved sensing techniques. Similarly, future advances for predicting transionospheric propagation require both improved models and sensing techniques. In the areas of ionospheric scintillations, both stochastic and morphological models are described. The need for an improved understanding of the solar and geomagnetic dependence of ionospheric scintillation is stressed. In addition, ground wave propagation is covered. An overview is also presented describing the structure of and the material available from the International Radio Consultative Committee. Author

N91-21405# European Space Agency, Paris (France).
L-BAND ANTENNA ARRAY WITH INTEGRATED PHASE SHIFTERS
Martin Leich (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen, Germany, F.R.) Nov. 1990 72 p Transl. into ENGLISH of Ein L-Band-Patch-Antennen-Arrary mit Integrierten Phasenschiebern (Oberpfaffenhofen, Fed. Republic of Germany, DLR), 1989 Original language document was announced as N90-24519
(ESA-TT-1215; DLR-FB-89-63; ETN-91-98973) Avail: NTIS HC/MF A04

The design and operation of an L band microstrip antenna with integrated phase shifters is described. The array consists of phase shifter antenna elements. The phase shifters have power handling capability and can be used with two different versions of microstrip antennas for constructing various phased array systems. The phase shifters and the antenna elements are integrated into a flat conformal unit. Linear arrays are simulated and tested. Promising applications are in mobile satellite communications and L band radar synthetic aperture radar systems. The development of compatible microstrip antenna excited with circular polarization would be useful for extending the application of the concept.
ESA

N91-21406# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
COMPARATIVE STUDY OF VLF SIGNALS IN THE SUB-ANTARCTIC REGION M.S. Thesis [ESTUDO COMPARATIVO DE SINAIS DE VLF NA REGIAO SUB ANTARTICA E NA SAGA]
Plinio Carlos Alvala Jul. 1990 102 p In PORTUGUESE; ENGLISH summary
(INPE-5165-TDL/426) Avail: NTIS HC/MF A06

The VLF phase signals of Omega Argentina (43 deg S; 65 deg W) at frequencies of 10.2 and 13.6 kHz received simultaneously at Antarctic Station Comandante Ferraz located at the Antarctic Peninsula (62 deg S; 58 deg W) and at the Radio Observatory of Itapetinga, Atibaia (23 deg S; 43 deg W) from Feb. 1986 to Mar. 1987 are analyzed. In this analysis only days with low magnetic activity (Sigma K(sub p) is less than 14) and without solar flare occurrence were taken into account. For the two propagation paths a detailed study comparing the behavior of phase in winter and summer was done. An evaluation is made for the relative phase variation to maximum solar illumination as a function of the solar zenith distance through the year for the two trajectories. The behavior of the two trajectories is obtained by comparison of diurnal phase variation showing the main characteristics of each propagation path. The monthly variation of both reflection height and nighttime reflection height is calculated using a theoretical and semi-empirical models for the two propagation paths. A comparison is also made between SPA (Sudden Phase Anomalies) events observed simultaneously at the two frequencies. In general, the results show good agreement with the models applied, except for the diurnal phase variations normalized to distances of the propagation paths, but they are consistent with results previously obtained for the sub-Antarctic region. Author

N91-21407# Lawrence Livermore National Lab., CA.
THE SINGLE ANTENNA INTERFEROMETER
J. P. Fitch 15 Jan. 1990 6 p Presented at the 1991 Institute of Electrical and Electronics Engineers (IEEE) International Conference on Acoustics, Speech and Signal Processing, Toronto, Ontario, 14-17 May 1991
(Contract W-7405-eng-48)
(DE91-007128; UCRL-JC-105984; CONF-9105122-1) Avail: NTIS HC/MF A02

Air and spaceborne platforms using synthetic aperture radars (SAR) have made interferometric measurement by using either two physical antennas mounted on one airframe or two passes of one antenna over a scene. A new interferometric technique using one pass of a single-antenna SAR system is proposed and demonstrated on data collected by the NASA-JPL AirSAR. Remotely sensed L-band microwave data are used to show the sensitivity of this technique to ocean surface features as well as a baseline for comparison with work by others using two-antenna system.
DOE

N91-21408# Arnold Engineering Development Center, Arnold Air Force Station, TN.
AEDC FOCAL PLANE ARRAY TEST CAPABILITY Final Report, Oct. 1987 - Sep. 1990
R. A. Nicholson and C. L. Steele Jan. 1991 60 p Prepared in cooperation with Calspan Corp., Arnold AFB, TN
(AD-A230846; AEDC-TR-90-31) Avail: NTIS HC/MF A04
CSCL 17/5

The focal plane array test facility provides complete radiometric characterization of detector arrays and hybrid arrays. Most testing is performed in the Focal Plane Characterization Chamber (FPCC), which provides a cold, low background environment for focal plane tests. An injection system on the chamber facilitates a high throughput rate and good economy of operation. Testing in the FPCC can involve either flooding the array with uniform blackbody radiation or focusing radiation on a single pixel. Focal plane voltage output and noise can be measured as functions of source irradiance, bias voltage, focal plane temperature, integration time, chopper frequency, and infrared background. Relative spectral response measurements are made in a test station involving a three-grating monochromator. Most critical performance parameters can be evaluated, including responsivity, noise equivalent input, dynamic range and linearity, radiometric stability, power consumption, recovery time, array uniformity, and crosstalk. In addition, a wide variety of data presentation formats is available.
GRA

N91-21409# Naval Ocean Systems Center, San Diego, CA.
SPECIFICATION FOR A STANDARD RADAR SEA CLUTTER MODEL Final Report
Richard A. Paulus Sep. 1990 50 p
(AD-A230848; NOSC/TD-1917) Avail: NTIS HC/MF A03
CSCL 17/9

A model for the average sea clutter radar cross section is proposed for the Oceanographic and Atmospheric Master Library. This model is a function of wind speed (or sea state), wind direction relative to the antenna, refractive conditions, radar antenna height, frequency, polarization, horizontal beamwidth, and compressed pulse length. The model is fully described, a FORTRAN 77 computer listing is provided, and test cases are given to demonstrate the proper operation of the program. Author (GRA)

N91-21410# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
SPEECH RECOGNITION USING KOHONEN NEURAL NETWORKS, DYNAMIC PROGRAMMING, AND MULTI-FEATURE FUSION M.S. Thesis
Francis S. Stowe Dec. 1990 311 p
(AD-A230951; AFIT/GE/ENG/90D-59) Avail: NTIS HC/MF A14
CSCL 25/4

The purpose of this thesis was to develop and evaluate the performance of a three-feature speech recognition system. The three features used were LPC spectrum, formants (F1/F2), and cepstrum. The system uses Kohonen neural networks, dynamic programming, and a rule-based, feature-fusion process which integrates the three input features into one output result. The first half of this research involved evaluating the system in a speaker-dependent atmosphere. For this, the 70 word F-16 cockpit command vocabulary was used and both isolated and connected speech was tested. Results obtained are compared to a two-feature system with the same system configuration. Isolated-speech testing yielded 98.7 percent accuracy. Connected-speech testing yielded 75/0 percent accuracy. The three-feature system performed an average of 1.7 percent better than the two-feature system for isolated-speech. The second half of this research was concerned with the speaker-independent performance of the system. First, cross-speaker testing was performed using an updated 86 word library. In general, this testing yielded less than 50 percent accuracy. Then, testing was performed using averaged templates.

This testing yielded an overall average in-template recognition rate of approximately 90 percent and an out-of-template recognition rate of approximately 75 percent. GRA

N91-21411# Rochester Univ., NY. Inst. of Optics.
EFFECTS OF SOURCE CORRELATIONS ON THE SPECTRUM OF RADIATED FIELDS
Avshalom Gamliel Sep. 1990 199 p
(Contract DAAL03-86-K-0173)
(AD-A230955; ARO-24626.177-PH-UIR) Avail: NTIS HC/MF A09 CSCL 20/3

It has long been assumed that the normalized spectrum of a radiated field remains invariant on propagation. Recent developments in coherence theory have demonstrated that, in general, the normalized spectrum of a radiated field changes on propagation depending on the state of coherence and the original spectrum of the source. This thesis examined the effect of the spatial correlations of the source fluctuations on the radiated fields. In investigating the radiation efficiency of three-dimensional, partially coherent, primary sources a method was developed for finding the correlation function that maximizes the radiation efficiency and the total power emitted by such sources. The case of quasi-homogeneous sources shows that the optimal degree of spatial coherence is sinkr'/kr' where r' is the offset and k is the wave number. The significance of this result is discussed in connection with blackbody radiation. In considering the effects of the source correlation on the spectrum of the radiation a simple physical configuration of two small sources demonstrated that one can choose correlation functions that give rise to line narrowing, line broadening, line shifting and line splitting. Similar results are also obtained when the full electromagnetic nature of the sources is taken into account. This fact is illustrated by considering radiation from two partially correlated linear dipoles. GRA

N91-21412# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
AN EMPIRICAL STUDY OF COMBINING COMMUNICATING PROCESSES IN A PARALLEL DISCRETE EVENT SIMULATION M.S. Thesis
Ann K. Lee Dec. 1990 89 p
(AD-A230982; AFIT/GCS/ENG/90D-08) Avail: NTIS HC/MF A05 CSCL 12/6

The primary goal of distributed discrete event simulations is to achieve speedup in simulation execution time by distributing the processing of the simulation over multiple processors. When partitioned for distribution in this fashion, simulations are typically partitioned such that there are more processes than processors. This thesis reviews existing methods for distributed discrete event simulations, and proposes general guidelines for efficient partitioning for a given communications topology based on empirical evidence. A performance analysis is conducted for two approaches to partitioning the system. The first method chosen is a mapping of multiple processes to a processor and the second approach utilizes a distributed event list approach, developed by Mannix. This approach combines smaller processes into a larger single process, incorporating a next event list similar to that used in a sequential simulation. Empirical studies compare the performance of the two approaches under a variety of conditions. The traditional Chandy-Mirsa approach to system partitioning is demonstrated to yield overall better performance than the distributed event list algorithm. General guidelines for partitioning the system for both approaches are developed based on the performance comparisons. GRA

N91-21413# Defence Research Establishment, Ottawa (Ontario).
DEFINITION OF THE CONCEPT OF AN INTERFEROMETRIC SPECTRUM ANALYZER FOR THE DETECTION OF FREQUENCY HOPPING RADIOS
Nicole Brousseau Oct. 1990 53 p
(AD-A231031; DREO-TN-90-20) Avail: NTIS HC/MF A04 CSCL 17/4

The concept of a high resolution, large bandwidth and high dynamic range acousto-optic spectrum analyser for the detection of frequency hopping radios is described. The high resolution is achieved by selecting large time-aperture Bragg cells while the high dynamic range is obtained by using heterodyne detection in an interferometric structure. The large bandwidth is produced by a scanning process. An example of the probability of detection for a specific selection of parameters is given. GRA

N91-21414# Scripps Institution of Oceanography, La Jolla, CA. Marine Physical Lab.
ANALYSIS OF 200 Hz CW TONE PROPAGATION SIGNAL RECORDED DURING THE SEPTEMBER 1987 VLA EXPERIMENT
Jean-Marie Q. Tran and William S. Hodgkiss Sep. 1990 117 p
(Contract N00014-89-K-0038)
(AD-A231053; MPL-TM-418; MPL-U-7/90) Avail: NTIS HC/MF A06 CSCL 17/1

This technical report discusses the analysis of the 200 Hz CW tone signals recorded on Julian Day 270 and 272, during the September 1987 Single Vertical Line Array Experiment in the North East Pacific. On Julian Day 270, a 200 Hz CW tone was projected for various time lengths and three different source depths, 165 km from the Vertical Line Array (VLA). On Julian Day 272, the 200 Hz source was towed away from the VLA for 10 hours at a speed of 5 kts. The signals were received by the VLA, which extended from a depth of 400 m to 1300 m. Power spectra between 0 and 250 Hz are presented for selected channels of the array. Vertical distribution of power across the Vertical Line Array is obtained for the signal and noise at 200 Hz. Finally, arrival structures of the signal and of the noise at 200 Hz, are obtained using conventional beamforming techniques. Nine data tapes, recorded during these transmissions, were processed, and the results are presented in this report. The comprehensive environmental information, collected during the experiment, allows the successful acoustic modeling of both the fixed range case, where range between the VLA and the source varied from 0 to 100 km. The CONGRATS ray-theory model of the GSM and the ATLAS normal mode model are used, produce similar results which are in good agreement with the experimental results. GRA

N91-21415# Scripps Institution of Oceanography, La Jolla, CA. Marine Physical Lab.
HIGH RESOLUTION BEAMFORMING ON LARGE APERTURE VERTICAL LINE ARRAYS: PROCESSING SYNTHETIC DATA
Jean-Marie Q. Tran and William S. Hodgkiss Sep. 1990 96 p
(Contract N00014-89-K-0038)
(AD-A231054; MPL-TM-419; MPL-U-8/90) Avail: NTIS HC/MF A05 CSCL 17/1

This technical memorandum studies the beamforming of large aperture line arrays deployed vertically in the water column. The work concentrates on the use of high resolution techniques. Two processing strategies are envisioned: (1) full aperture coherent processing which offers in theory the best processing gain; and (2) subaperture processing which consists in extracting subapertures from the array and recombining the angular spectra estimated from these subarrays. The conventional beamformer, the minimum variance distortionless response (MVDR) processor, the multiple signal classification (MUSIC) algorithm and the minimum norm method are used in this study. To validate the various processing techniques, the ATLAS normal mode program is used to generate synthetic data which constitute a realistic signals environment. A deep-water, range-independent sound velocity profile environment, characteristic of the North-East Pacific, is being studied for two different 128 sensor arrays: a very long one cut for 30 Hz and operating at 20 Hz; and a shorter one cut for 107 Hz and operating at 100 Hz. The simulated sound source is 5 m deep. The full aperture and subaperture processing are being implemented with curved and plane wavefront replica vectors. The beamforming results are examined and compared to the ray-theory results produced by the generic sonar model. GRA

N91-21416# Mitre Corp., Bedford, MA.
NOISE FACTOR AND ANTENNA GAINS IN THE SIGNAL/NOISE EQUATION FOR OVER-THE-HORIZON RADAR
M. M. Weiner Aug. 1990 23 p
(AD-A231203; MTR-10989) Avail: NTIS HC/MF A03 CSCL 17/9

The prediction signal-to-noise ratio (SNR) of a radar or communication system is proportional to the power gain of the transmit antenna and the directive gain of the receive antenna, and is inversely proportional to the operating noise factor of the receiving system. The operating noise factor is approximately equal to the product of the external noise factor and the signal/noise processing factor when the system is external noise-limited, as is usually the case for over-the-horizon (OTH) radar. Unfortunately, the form of the singal/noise equation that is employed for some applications, particularly OTH radar, often does not explicity yield these results. It is recommended that the form of the signal/noise equation be amended to explicity yield these results rather than equivalent implicit results. Author (GRA)

N91-21417# Ohio State Univ., Columbus. Electroscience Lab.
TRANSITIVE, ANTI-SYMMETRIC RELATIONAL ATTRIBUTES IN STRUCTURAL DESCRIPTION MATCHING WITH APPLICATIONS TO RADAR TARGET IDENTIFICATION
O. S. Sands and F. D. Garber Oct. 1990 138 p
(Contract N00014-90-J-1200)
(AD-A231318; ESL-TR-723090-1) Avail: NTIS HC/MF A07 CSCL 17/9

A structural pattern recognition system for a radar target identification system is described. Segmentation of a radar measurement series is accomplished with a Prony-based estimation procedure. Matching of structural descriptions is developed for structural descriptions with specialized relational attributes and for which an inter-node-set distance function is available. The reformulated matching theory is applied to the radar target identification problem. The radar measurement process is described in detail. A parametric model for the measurement series is given. An estimation process for the parametric model is briefly described and the energy localization properties of the estimation process are made explicit. The effects of noise on a parametric decomposition are discussed. An alternative framework for the matching of structural descriptions is developed. This development includes a number of qualifications applied to the standard structural description framework. A required inter-node-set distance function is used to define an inter-structural-description distance. Qualifications applied to the relational portion of the structural description formalism lead to the use of registration parameters for resolution of relational discrepancies. GRA

N91-21418# Army Cold Regions Research and Engineering Lab., Hanover, NH.
UHF MODEL SIMULATION OF DETECTING VOIDS IN A DIELECTRIC MEDIUM USING HF-VHF AIRBORNE SHORT-PULSE RADAR
Steven A. Arcone Dec. 1990 18 p
(AD-A231495; CRREL-90-11) Avail: NTIS HC/MF A03 CSCL 17/9

This paper discusses the results of a scale model operating in the UHF band to study the use of frequencies below 100 MHz in the HF (3 to 30 MHz) to VHF (30 to 300 MHz) bands for an airborne survey to detect voids in a dielectric medium of low conductivity, such as crystalline bedrock or ice. The airborne mode is chosen for its high rate of ground coverage. GRA

N91-21419# IIT Research Inst., Chicago, IL.
ELF COMMUNICATIONS SYSTEM, ECOLOGICAL MONITORING PROGRAM: SUMMARY OF 1989 PROGRESS
Technical Report, 1 Jan. - 31 Dec. 1989
Joun E. Zapotosky Nov. 1990 78 p
(Contract N00039-88-C-0065)
(AD-A231497; IITRI-E06628-1) Avail: NTIS HC/MF A05 CSCL 25/2

A long term ecological monitoring program is being conducted to monitor for possible electromagnetic effects that operation of the U.S. Navy's ELF communications system might have on resident biota and their ecological relationships. Monitoring studies were selected through a peer-reviewed, competitive bidding process in mid-1982, and work on most studies began in late summer of that year. Preliminary activities of the program consisted of site selection. Characterization of critical study aspects, and validation of assumptions made in original proposals. Data collection for studies at the Naval Radio Transmitting Facility (NRTF)-Clam Lake, Wisconsin, was completed, as scheduled, during 1989. Data collection for studies at the NRTF-Republic, Michigan, is planned to continue through 1991. This report summarizes the progress of the monitoring program during 1989. To date, investigators conclude that no effects have occurred on biota exposed to electromagnetic fields produced by either a fully operational or an intermittently energized ELF transmitting facility. GRA

N91-21420# Air Force Inst. of Tech., Wright-Patterson AFB, OH.
APPLICATION OF THE FINITE ELEMENT METHOD TO RANDOM ROUGH SURFACE SCATTERING WITH NEUMANN BOUNDARY CONDITIONS M.S. Thesis
Kevin Krause 1990 51 p
(AD-A231583; AFIT/CI/CIA-90-136) Avail: NTIS HC/MF A04 CSCL 12/1

Scattering from a one-dimensional rough surface with Gaussian roughness spectrum is analyzed using a finite element formulation. The method is applied to Monte Carlo simulations satisfying Neumann boundary conditions. Finite element results are compared with results obtained by solving an integral equation. Convergence of the method is verified by varying the number of nodal points in the first order, triangular mesh. Results are in excellent agreement with tapered wave integral equation solutions for large surface length after averaging over realizations. Finite element advantages in time and memory storage are presented for the examples discussed. Comparisons with the Kirchoff approximation and small perturbation theory within their respective regions of validity are also presented. Additionally, analysis of the effects of decreasing surface length on incoherent scattering results of the finite element method is accomplished to investigate the method's likely advantages for large-scale scattering problems. Numerical results of scattering are represented in terms of the normalized bistatic scattering cross section. GRA

N91-21421# Naval Research Lab., Washington, DC.
EFFICIENT APPROACHES FOR REPORT/CLUSTER CORRELATION IN MULTITARGET TRACKING SYSTEMS
Jeffrey K. Uhlmann, Miguel R. Zuniga, and J. M. Picone 31 Dec. 1990 14 p
(Contract N00014-86-C-2197)
(AD-A231589; NRL-9281) Avail: NTIS HC/MF A03 CSCL 17/11

Gating is an important component of most multi-object tracking systems. Its function is to identify sensor reports, e.g., radar or infrared (IR) returns from missiles, planes, etc., that correlate highly with current state estimates (i.e., tracks). For small numbers of objects, it is feasible to calculate a probability of correlation for every track/report pair and reject those whose probabilities fall below some threshold. For large numbers of objects, however, the quadratic growth in the number of pairs for which correlation probabilities are computed by this brute force approach represents an enormous bottleneck. This combination problem is of particular concern in Strategic Defense Initiative (SDI) tracking and correlation for which numbers of objects on the order of 100,000 must be processed in real time. This report discusses an approach that significantly reduces the computational complexity of the correlation process in the TRC tracking and correlation system developed at the Naval Research Laboratory. TRC is a multihypothesis tracker/correlator that was developed to conduct experiments in multiple-target tracking. Unfortunately, early tests of the TRC revealed that combinatorial problems severely limited the size of the scenarios that could be examined. Subsequent analysis

demonstrated that these limitations were the result of a correlation (gating) algorithm that scaled in time quadratically in the size of the scenarios that could be examined. GRA

N91-21422# ARC Professional Service Group, Inc., Rockville, MD. Defense Systems Div.
TEST REPORT FOR PHOTONIC SENSORS USED IN ELECTRIC FIELD MEASUREMENT OF SIMULATED ELECTROMAGNETIC PULSES Final Report, 28 - 30 Aug. 1990
Roland Blocksom and Roger Bucholz Jan. 1991 180 p
(Contract N00014-90-C-2033; W12-77)
(AD-A231597; TR-2924) Avail: NTIS HC/MF A09 CSCL 14/2

The results are presented of tests to record and analyze the characteristic response of three photonic Electric field (E-field sensors to simulated Electromagnetic Pulse (EMP), compared to that of a reference metallic sensor. Investigations included: (1) selection of candidate sensors capable of measuring the E-field content (intensity and frequency spectrum) of simulated EMP phenomena generated by the Horizontally Polarized Dipole (HPD) EMP simulator at the Naval Air Test Center (NATC), Patuxent River, MD; (2) liaison with sensor designers, NATC personnel, and others as necessary to delineate test requirements and constraints; (3) development of a sensor test plan; (4) sensor tests in the HPD EMP simulation; (5) analysis of the test data; and (6) generation of the Test Report. A R&D effort was conducted to produce a prototype fiber optic sensor system for application to EMP field measurement. GRA

N91-21423# Air Force Inst. of Tech., Wright-Patterson AFB, OH.
USING THE USU IONOSPHERIC MODEL TO PREDICT RADIO PROPAGATION THROUGH A SIMULATED IONOSPHERE M.S. Thesis
Gary R. Huffines 1990 75 p
(AD-A231599; AFIT/CI/CIA-90-150) Avail: NTIS HC/MF A04 CSCL 20/14

To evaluate the capabilities of communication, navigation, and defense systems utilizing electromagnetic waves which interact with the ionosphere, a three-dimensional ray tracing program was used. A simple empirical model (Chapman function) and a complex physical model (Schunk and Sojka model) were used to compare the representation of ionospheric conditions. Four positions were chosen to test four different features of the Northern Hemispheric ionosphere. It seems that decreasing electron density has little or no effect on the horizontal components of the ray path while increasing electron density causes deviations in the ray path. It was also noted that rays in the physical model's mid-latitude trough region escaped the ionosphere for all frequencies used in this study. GRA

N91-21424# Army Construction Engineering Research Lab., Champaign, IL.
CONSTRUCTION SITE VOICE OPERATED INFORMATION SYSTEM (VOIS) TEST Final Report
Debbie J. Lawrence and William Hettchen Jan. 1991 43 p
(AD-A231633; CERL-TR-M-91/12) Avail: NTIS HC/MF A03 CSCL 25/4

The Voice Activated Information System (VAIS), developed by USACERL, allows inspectors to verbally log on-site inspection reports on a hand held tape recorder. The tape is later processed by the VAIS, which enters the information into the system's database and produces a written report. The Voice Operated Information System (VOIS), developed by USACERL and Automated Sciences Group, through a ESACERL cooperative research and development agreement (CRDA), is an improved voice recognition system based on the concepts and function of the VAIS. To determine the applicability of the VOIS to Corps of Engineers construction projects, Technology Transfer Test Bad (T3B) funds were provided to the Corps of Engineers National Security Agency (NSA) Area Office (Fort Meade) to procure and implement the VOIS, and to train personnel in its use. This report summarizes the NSA application of the VOIS to quality assurance inspection of radio frequency shielding and to progress payment logs, and concludes that the VOIS is an easily implemented system that can offer improvements when applied to repetitive inspection procedures. Use of VOIS can save time during inspection, improve documentation storage, and provide flexible retrieval of stored information. GRA

N91-21163# Micro Electronics A.S. Space, Horten (Norway).
APPLICATION OF SAW TECHNOLOGY IN SATELLITES FOR MOBILE SERVICES
O. Andreassen, V. Viddal, and J. Galteland *In* Norwegian Space Center, From Earth to Space and Back: Selected Papers on Norwegian Space Activities Mar. 1990 p 19-23 Previously announced in IAA as A90-26854 (For primary document see N91-21159 13-12)
Avail: NTIS HC/MF A04

N91-21164# ELAB-RUNIT, Trondheim (Norway).
SAW TECHNOLOGY FOR MULTICARRIER DEMODULATION IN ADVANCED PAYLOADS
Vidar Ringset, Erik Olsen, Arne Roennekleiv, Petter Bakken, and Gunnar Bjoernstroem (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* Norwegian Space Center, From Earth to Space and Back: Selected Papers on Norwegian Space Activities Mar. 1990 p 24-30 Previously announced in IAA as A91-22923 Sponsored by Royal Norwegian Council for Scientific and Industrial Research and Norwegian Space Center, Oslo (For primary document see N91-21159 13-12)
(Contract ESA-6899/86/NL(SC))
Avail: NTIS HC/MF A04

33 ELECTRONICS AND ELECTRICAL ENGINEERING

Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry.

For related information see also *60 Computer Operations and Hardware* and *76 Solid-State Physics.*

N91-21425# Xerox Palo Alto Research Center, CA. Systems Sciences Lab.
COMPARING STRUCTURALLY DIFFERENT VIEWS OF A VLSI DESIGN Thesis
Mike Spreitzer Jun. 1990 162 p Presented at the 27th ACM IEEE Design Automation Conference, Jun. 1990 Submitted for publication
(PB91-111757; CSL-90-4) Avail: NTIS HC/MF A08 CSCL 09A

One of the major problems of Very Large Scale Integration (VLSI) is coping with the quantity and complexity of the design data. The leading solutions use divide-and-conquer techniques. Two different ways of dividing are popular: division by a structural hierarchy, and division into various levels of abstraction (a view is a description at a particular level of abstraction). The VLSI designs are so large and complex that both divisions are needed, which raises a question: should all the views of a design use the same hierarchy. The question is currently controversial. The dissertation, while not presuming to settle that question, argues in favor of allowing the view to have different hierarchies, and addresses a problem that is complicated by differences in hierarchy. That is the comparison problem, which has two parts: verify consistency between alternate views, and determine the correspondence between the design entities of those views. A new comparison method, Informed Comparison, which neither requires the views to have essentially identical hierarchies nor flattens the views is introduced. Informed Comparison requires the designers to maintain a key, which is a description of the intended relation between the hierarchies of the views. GRA

N91-21426*# Toledo Univ., OH. Dept. of Electrical Engineering.

A DEMONSTRATION OF CMOS VLSI CIRCUIT PROTOTYPING IN SUPPORT OF THE SITE FACILITY USING THE 1.2 MICRON STANDARD CELL LIBRARY DEVELOPED BY NATIONAL SECURITY AGENCY Final Report

Edwyn D. Smith Mar. 1991 66 p

(Grant NAG3-1036)

(NASA-CR-188014; NAS 1.26:188014) Avail: NTIS HC/MF A04 CSCL 09C

Two silicon CMOS application specific integrated circuits (ASICs), a data generation chip, and a data checker chip were designed. The conversion of the data generator circuitry into a pair of CMOS ASIC chips using the 1.2 micron standard cell library is documented. The logic design of the data checker is discussed. The functions of the control circuitry is described. An accurate estimate of timing relationships is essential to make sure that the logic design performs correctly under practical conditions. Timing and delay information are examined. B.G.

N91-21427*# Lockheed Engineering and Sciences Co., Houston, TX. Power Distribution/Control Section.

KAPTON WIRE ARC TRACK TESTING: PER TEST PROCEDURE KWATT BB01

Oct. 1990 108 p

(Contract NAS9-17900)

(NASA-CR-185642; NAS 1.26:185642) Avail: NTIS HC/MF A06 CSCL 09C

The results are presented of Kapton wire arc tracking tests performed at NASA-Johnson in 1990 using test procedure KWATT BB01. The tests were performed to gather data for use in assessing the safety of the Space Shuttle Orbiter wiring which is predominantly Kapton insulated. Author

N91-21428# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.

SILICON HYBRID WAFER SCALE INTEGRATION (WSI) USED TO FABRICATE A HILBERT TRANSFORM INTEGRATED CIRCUIT MODULE M.S. Thesis

Daniel J. Gaughan Dec. 1990 97 p

(AD-A230605; AFIT/GE/ENG/90D-22) Avail: NTIS HC/MF A05 CSCL 09/1

This research was performed in order to develop a superior processing schedule for fabricating wafer-scale integration (WSI) circuit modules. This technology allows the design of circuitry that spans the entire surface of a silicon substrate wafer. The circuit element employed in this research was the Hilbert transform, a digital phase-shifting circuit. The transform was incorporated into a three integrated circuit (IC) die package that consisted of a mechanically supportive silicon wafer, three IC die, and a planarizing silicon wafer. The die were epoxied into this wafer using a Teflon block as a flat, and the combination was epoxied onto the substrate wafer, forming the IC module. The original design goals of this research were to keep the IC die and wafer planar and to electrically characterize of the module's interconnections. The first goal was met; the resultant process uses a low temperature (50 C) cure to achieve die-to-wafer planarity of within 5 microns. The second was not met due to the inability to pattern the chosen photosensitive dielectric material. Recommendations for further research included the need to use a stable non-stick surface as a epoxy cure fixture and the need to investigate the photopatternable dielectric material. GRA

N91-21429# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.

NUMERICAL APPROXIMATIONS OF THE GREEN'S FUNCTIONS FOR A THEORETICAL MODEL OF AN APERTURE FED STACKED-PATCH MICROSTRIP ANTENNA M.S. Thesis

Ronald E. Erwert Dec. 1990 95 p

(AD-A230702; AFIT/GE/ENG/90D-19) Avail: NTIS HC/MF A05 CSCL 09/1

Each complex valued Green's function was written as a function of the source-observer separation. The behavior of each Green's function was analyzed, and it was found that they could all be approximated by three separate functions. The approximating functions were either polynomials or rational functions composed of polynomials. One component could be approximated by a single function over the entire range of radial separations, while the other required a piecewise approximation over the same intervals for each function approximated. The coefficients of the functions were determined by using a least squares curve fitting method and were used in a separate effort to perform a moment method analysis of the antenna. Custom written FORTRAN code was developed to determine the coefficients of the approximations. Example results for several of the Green's functions approximated are presented in this thesis. The agreement between the approximations and the original functions was excellent. GRA

N91-21430*# Hughes Aircraft Co., El Segundo, CA. Electro-Optical and Data Systems Group.

HIGH RELIABILITY MEGAWATT TRANSFORMER/RECTIFIER Final Report, Sep. 1989 - Oct. 1990

Samuel Zwass, Harry Ashe, and John W. Peters Mar. 1991 49 p

(Contract NAS3-25801)

(NASA-CR-187079; NAS 1.26:187079; Hughes/EDSG-R160153) Avail: NTIS HC/MF A03 CSCL 09A

The goal of the two phase program is to develop the technology and design and fabricate ultralightweight high reliability DC to DC converters for space power applications. The converters will operate from a 5000 V dc source and deliver 1 MW of power at 100 kV dc. The power weight density goal is 0.1 kg/kW. The cycle to cycle voltage stability goals was + or - 1 percent RMS. The converter is to operate at an ambient temperature of -40 C with 16 minute power pulses and one hour off time. The uniqueness of the design in Phase 1 resided in the dc switching array which operates the converter at 20 kHz using Hollotron plasma switches along with a specially designed low loss, low leakage inductance and a light weight high voltage transformer. This approach reduced considerably the number of components in the converter thereby increasing the system reliability. To achieve an optimum transformer for this application, the design uses four 25 kV secondary windings to produce the 100 kV dc output, thus reducing the transformer leakage inductance, and the ac voltage stresses. A specially designed insulation system improves the high voltage dielectric withstanding ability and reduces the insulation path thickness thereby reducing the component weight. Tradeoff studies and tests conducted on scaled-down model circuits and using representative coil insulation paths have verified the calculated transformer wave shape parameters and the insulation system safety. In Phase 1 of the program a converter design approach was developed and a preliminary transformer design was completed. A fault control circuit was designed and a thermal profile of the converter was also developed. Author

N91-21431# Nationaal Inst. voor Kernfysica en Hoge Energiefysica, Amsterdam (Netherlands).

PRINCIPLE, ADVANTAGES AND DISADVANTAGES OF A dc CURRENT TRANSFORMER (DCCT) [HET PRINCIPE, EN VOOR- EN NADELEN, VAN EEN GELIJKSTROOMTRANSFORMATOR (DCCT)]

J. T. vanEs and H. Verkooijen 1990 16 p In DUTCH

(DIGEL-1990-5; ETN-91-99050) Avail: NTIS HC/MF A03

The operation and different possible designs of a dc Current Transformer (DCCT) for the measurement of large currents are studied. The principles of peak detection and synchronous detection are outlined, and their advantages and disadvantages are discussed. The designs of excitation coil, excitation filter, synchronous detector, proportional integration control, and output filter are presented. The resolution of the measuring system is mainly determined by the material of the transformer core and by the quality factor of the excitation filter. For an optimal result the transformer has to function as a comparator. ESA

N91-21432# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

STUDY OF ASYMMETRICAL ELECTRIC DISCHARGES USING PARTICLE SIMULATION

Maria Virginia Alves Nov. 1990 132 p In PORTUGUESE; ENGLISH summary

(INPE-5198-TDL/427) Avail: NTIS HC/MF A07

Asymmetrical electric discharges are widely used in the microelectronics industry. The asymmetry in the electrode areas determines the magnitude of the plasma-to-electrode voltage (V sub a) at the powered electrode, which determines the ion bombarding energy. Two many-particle simulation codes, PDC1 and PDC2, were developed. These codes are electrostatic, one-dimensional (radial) and model a bounded plasma between two infinite cylinders or two concentric spheres that can be connected to an RLC external circuit. Both codes consider asymmetrical electrode areas. In order to simulate electrical discharges, Monte-Carlo simulation of electron-neutral and ion-neutral collisions were included. These codes were used to study the relationship between the voltage area ratio across the sheaths, V(sub a)/V(sub b), and the electrode area ratio A(sub b)/A(sub a). Simulation results agree with experimental results and also with the analytical model that includes local ionization near the electrodes which is observed to occur in almost all of the simulations. Author

N91-21433*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

OPTIMAL DESIGN STUDY OF HIGH EFFICIENCY INDIUM PHOSPHIDE SPACE SOLAR CELLS

Raj K. Jain and Dennis J. Flood Nov. 1990 7 p Presented at the 5th International Photovoltaic Science and Engineering Conference, Kyoto, Japan, 26-30 Nov. 1990; sponsored in part by Japan Society of Applied Physics; the Inst. of Electrical Engineers of Japan; and Foundation for the Advancement o

(NASA-TM-103763; E-6025; NAS 1.15:103763) Avail: NTIS HC/MF A02 CSCL 10A

Recently indium phosphide solar cells have achieved beginning of life AMO efficiencies in excess of 19 pct. at 25 C. The high efficiency prospects along with superb radiation tolerance make indium phosphide a leading material for space power requirements. To achieve cost effectiveness, practical cell efficiencies have to be raised to near theoretical limits and thin film indium phosphide cells need to be developed. The optimal design study is described of high efficiency indium phosphide solar cells for space power applications using the PC-1D computer program. It is shown that cells with efficiencies over 22 pct. AMO at 25 C could be fabricated by achieving proper material and process parameters. It is observed that further improvements in cell material and process parameters could lead to experimental cell efficiencies near theoretical limits. The effect of various emitter and base parameters on cell performance was studied. Author

N91-21434* National Aeronautics and Space Administration. Pasadena Office, CA.

LATERALLY STACKED SCHOTTKY DIODES FOR INFRARED SENSOR APPLICATIONS Patent

True-Lon Lin, inventor (to NASA) (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) 5 Feb. 1991 5 p Filed 9 Jun. 1989 Supersedes N90-10329 (28 - 1, p 58)

(Contract NAS7-918)

(NASA-Case-NPO-17426-1-CU; US-Patent-4,990,988; US-Patent-Appl-SN-363815; US-Patent-Class-357-30; US-Patent-Class-357-15; US-Patent-Class-357-67S; US-Patent-Class-357-71S; Int-Patent-Class-H01L-27/14) Avail: US Patent and Trademark Office CSCL 09A

Laterally stacked Schottky diodes for infrared sensor applications are fabricated utilizing porous silicon having pores. A Schottky metal contract is formed in the pores, such as by electroplating. The sensors may be integrated with silicon circuits on the same chip with a high quantum efficiency, which is ideal for IR focal plane array applications due to uniformity and reproducibility.

Official Gazette of the U.S. Patent and Trademark Office

N91-21435*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

PHASE-LOCK-LOOP APPLICATION FOR FIBER OPTIC RECEIVER

Stephen L. Ruggles and Robert W. Wills Feb. 1991 22 p

(NASA-TM-102776; NAS 1.15:102776) Avail: NTIS HC/MF A03 CSCL 09A

Phase-locked loop circuits are frequently employed in communication systems. In recent years, digital phase-locked loop circuits were utilized in optical communications systems. In an optical transceiver system, the digital phase-locked loop circuit is connected to the output of the receiver to extract a clock signal from the received coded data (NRZ, Bi-Phase, or Manchester). The clock signal is then used to reconstruct or recover the original data from the coded data. A theoretical approach to the design of a digital phase-locked loop circuit operation at 1 and 50 MHz is described. Hardware implementation of a breadboard design to function at 1 MHz and a printed-circuit board designed to function at 50 MHz were assembled using emitter coupled logic (ECL) to verify experimentally the theoretical design. Author

N91-21436# California Univ., Berkeley. Lawrence Berkeley Lab.

TEST RESULTS OF A 90 MHz INTEGRATED CIRCUIT SIXTEEN CHANNEL ANALOG PIPELINE FOR SSC DETECTOR CALORIMETRY

S. A. Kleinfelder, M. Levi, and O. Milgrome Oct. 1990 4 p Presented at the Symposium on Detector Research and Development for the Superconducting Super Collider, Fort Worth, 15-18 Oct. 1990

(Contract DE-AC03-76SF-00098)

(DE91-009773; LBL-30222; CONF-9010212-41) Avail: NTIS HC/MF A01

A sixteen channel analog transient recorder with 128 cells per channel has been fabricated as an integrated circuit and tested at speeds of up to 90 MHz. The circuit uses a switched capacitor array technology to achieve a simultaneous read and write capability and twelve bit dynamic range. The high performance of this part should satisfy the demanding electronics requirements of calorimeter detectors at the SSC. The circuit parameters and test results are presented. DOE

N91-21437# Massachusetts Inst. of Tech., Lexington. Lincoln Lab.

ESTIMATING POWER AMPLIFIER LARGE SIGNAL GAIN

Lawrence J. Kushner Jun. 1990 9 p Previously announced in IAA as A90-39738 Submitted for publication

(Contract F19628-90-C-0002)

(AD-A230823; JA-6282; ESD-TR-90-154) Avail: NTIS HC/MF A02 CSCL 09/1

Microwave power amplifier large signal gain is determined by calculating the input power needed to produce a given output power. Both closed-form solutions and a CAD-based solution are presented, all based on device DCI-V characteristics and small signal models. A practical power amplifier design procedure is given and used to design a 22 GHz permeable base transistor (PBT) power amplifier. Although the analysis and design results presented here are useful by themselves, they also are intended to be used in conjunction with other CAD and measurement techniques, such as harmonic balance and load pull, to arrive at a starting point. Device designers should find these results useful, allowing them to predict how changes in a device's parameters will affect its microwave power amplifier performance.

Author (GRA)

N91-21438# Clemson Univ., SC.

ANALYSIS AND DESIGN OF ANTENNA STRUCTURES: DIAKOPTIC THEORY AND THE MOMENT METHOD Final Report, 1 Dec. 1985 - 30 Sep. 1990

Chalmers M. Butler Nov. 1990 10 p

(Contract DAAL03-86-K-0020)
(AD-A230838; ARO-23554.4-EL-A) Avail: NTIS HC/MF A02 CSCL 09/1

A goal of the research project was to develop the modified diakoptic theory into an efficient method for analyzing and designing antenna structures and distributed parameter circuits. A second goal of the project was to develop the numerical methods needed to implement the analysis techniques. A final goal was to perform laboratory measurements whose date enable one to corroborate the accuracy of the theoretical/numerical methods of the modified diakoptic theory. The three goals were realized. GRA

N91-21439# Maryland Univ., College Park.
MODELING FAILURE AND RELIABILITY IN NEW-GENERATION DEVICES
Jeffrey Frey 15 Jul. 1990 25 p
(Contract DAAL03-88-K-0115)
(AD-A230998; ARO-25842.5-EL) Avail: NTIS HC/MF A03 CSCL 09/1

A two-dimensional device simulation program (UMDFET) designed to produce information on the reliability of both silicon and compound-semiconductor electron devices was constructed. The program uses either the drift-diffusion description of carrier transport, for relatively large devices, or the newer energy transport method of solving the Boltzmann Transport Equation, for submicron-scale devices. Multi-layered heterostructure MESFETs, as well as silicon MOSFETs, may be simulated. UMDFET has been used to examine performance and reliability of silicon MOSFETs with channel lengths below 0.2 micron, showing that reliability of such small devices is not as great a problem as was originally thought. This report comprises abstracts of papers submitted, presented at conferences, and published in journals, based on work performance under the referenced grant. GRA

N91-21440# Syracuse Univ., NY. School of Computer and Information Science.
TEST GENERATION FOR DIGITAL CIRCUITS USING PARALLEL PROCESSING Final Report, Jun. 1989 - Jun. 1990
Carlos R. Hartmann and Akhtar-uz-Zaman M. Ali Dec. 1990 72 p
(Contract F30602-88-D-0027)
(AD-A231006; RADC-TR-90-346) Avail: NTIS HC/MF A04 CSCL 09/1

The problem of test generation for digital logic circuits is an NP-Hard problem. Recently, the availability of low cost, high performance parallel machines has spurred interest in developing fast parallel algorithms for computer-aided design and test. This report describes a method of applying a 15-valued logic system for digital logic circuit test vector generation in a parallel programming environment. A concept called fault site testing allows for test generation, in parallel, that targets more than one fault at a given location. The multi-valued logic system allows results obtained by distinct processors and/or processes to be merged by means of simple set intersections. A machine-independent description is given for the proposed algorithm. GRA

N91-21441# George Washington Univ., Hampton, VA. Joint Inst. for Advancement of Flight Sciences.
EFFECTIVE COMPUTATIONAL STRATEGY FOR PREDICTING THE RESPONSE OF COMPLEX SYSTEMS Final Report, 1 Mar. - 31 Aug. 1990
Ahmed K. Noor 1 Oct. 1990 60 p
(Grant AF-AFOSR-0252-90; AF Proj. 2302)
(AD-A231153; AFOSR-90-1225TR) Avail: NTIS HC/MF A04 CSCL 09/1

An effective computational strategy is developed for generating the response of complex systems using (small or large) perturbations from the response of a simple structure (or a simpler mathematical/discrete model of the original structure). Two general approaches are developed for selecting the simpler model and establishing the relations between the original and simpler models. The two approaches are: decomposition or partitioning strategy, and hierarchical modeling strategy. Two effective partitioning strategies are used. The first is based on uncoupling of load-carrying mechanisms, and the second is based on symmetry transformations. The hierarchical modeling used is the predictor-corrector iterational process based on using a simple mathematical model in the predictor phase and correcting the response using a more accurate mathematical model. GRA

N91-21442# Ballistic Research Labs., Aberdeen Proving Ground, MD.
AB INITIO STUDY OF THE ELECTRIC DIPOLE TRANSITION MOMENT FOR THE ELECTRONIC X TO C TRANSITION IN ACETYLENE: THEORETICAL PREDICTIONS OF THE ABSORPTION AND MAGNETIC CIRCULAR DICHROISM INTENSITIES Final Report, Sep. 1988 - May 1990
James O. Jensen, George F. Adams, and Cary F. Chabalowski Dec. 1990 31 p
(AD-A231227; BRL-TR-3183) Avail: NTIS HC/MF A03 CSCL 07/3

The electric dipole transition moment has been cancelled a priori for the electronic transition as a function of R(C-C), using ab initio quantum chemical techniques including state averaged, complete active space MCSCF and multireference CI. The transition moment is then averaged over the vibrational wavefunctions for the C-C stretch, and theoretical predictions are made for the absorption oscillator strength and the magnetic circular dichroism (MCD) intensities, for the lowest four vibrational bands originating from v=0 in X. This study predicts an oscillator strength for absorption of f=0.157 (summed over v'=0-3), to be compared to an early experimental value of 0.062 +/- 0.0092. And for the MCD 0-0 band, the calculations predict 0.0179 while the experimental value is reported to be 0.0125 +/- 0.001 (cgs units). GRA

N91-21443# Defence Research Establishment, Ottawa (Ontario).
IMPLEMENTATION OF FFT AND PULSE COMPRESSION ROUTINES ON THE SPT FREQUENCY DOMAIN ARRAY PROCESSOR
V. Behroozi and A. Damini Sep. 1990 57 p
(AD-A231320; DREO-1041) Avail: NTIS HC/MF A04 CSCL 09/1

The Frequency Domain Array Processor (FDAP) is a VME compatible circuit board built by Signal Processing Technologies (SPT). The FDAP can process integer data arrays containing up to 8192 (32 bit) complex words or 1684 (16 bit) real words. It is capable of 400 Million Operations Per Second (MOPS) with a maximum Input/Output (I/O) rate of four billion bits per second. It also has a double buffered memory architecture permitting I/O transfers to occur in parallel with data processing. The FDAP can be hosted by an IBM PC/AT-compatible computer using a bus adaptor interface available from BIT3 Computer Corp. The FDAP board is based upon SPT's DASP/PAC chip set. This chip set and the varios system architectures which can be built around it are reviewed. The FDAP board and its associated development system are also reviewed. The ease of implementation of typical radar signal processing functions on the FDAP board are then examined. Fast Fourier Transform and pulse compression routines are implemented via a supplied user interface as well as a high level language (C). The results are examined and comments on the FDAP and its associated system development tools are made. GRA

N91-21444# Naval Research Lab., Washington, DC.
TRANSVERSE KLYSTRON Interim Report
Y. Seo and P. Sprangle 31 Jan. 1991 34 p Prepared in cooperation with FM Technologies, Inc., Fairfax, VA
(AD-A231586; NRL-MR-6756) Avail: NTIS HC/MF A03 CSCL 09/1

An analytic solution is presented for the longitudinal density modulation of a bending magnet with a transverse scanning electron beam. The analysis is carried out for the cases with and without a guiding magnetic field. Dependence of the electron bunching on various design parameters is clarified in both cases.

In the case without a guide field, the beam focusing properties, and the effects of energy spread and self-field are studied. The focusing conditions are determined and a condition for cancelling the effect of energy spread is found. It is shown, moreover, that the self-field enhances electron bunching in the bending magnet due to the negative mass effect. In the case with a guide field, a resonant excitation in the modulation cavity is considered in order to enhance the transverse modulation. A configuration with a half cusp field has also been considered to avoid the difficulty in scanning modulation in the presence of the guide field. GRA

N91-21445# Army Lab. Command, Fort Monmouth, NJ. Electronics Technology and Devices Lab.
QUARTZ CRYSTAL RESONATORS AND OSCILLATORS FOR FREQUENCY CONTROL AND TIMING APPLICATIONS: A TUTORIAL, REVISION 4
John R. Vig Jan. 1991 172 p Supersedes report dated Jan. 1990, AD-A218090 and interim changes
(AD-A231604; SLCET-TR-88-1-Rev-4.1) Avail: NTIS HC/MF A08 CSCL 14/2

Subjects covered include: applications of frequency standards; types of oscillators; quartz resonator properties; quartz growth; sweeping, and material characteristics; Q and its significance; resonator and oscillator stability, including aging, short-term instability, frequency vs. temperature characteristics, oscillator circuit caused instabilities, frequency vs. drive level effects, acceleration effects the effect of shock, and radiation effects; emerging technologies; atomic frequency standards; comparison of the major oscillator types; time and timekeeping; clock errors; relativistic time; time transfer; time and frequency subsystem; and other applications of quartz resonators. The goal of this document is to assist in presenting to the nonspecialist the most frequently encountered concepts in frequency control and timing. The document originated as a set of hard copies of presentation visuals (i.e., vu-graphs). GRA

N91-22046# Space Research Organization Netherlands, Groningen. Lab. for Space Research.
THE mm AND SUB-mm WAVE PLANAR ANTENNA ARRAYS FOR SIS DETECTORS
Herman vandeStadt, Thijs deGraauw, and A. Skalare *In* ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 365-368 (For primary document see N91-21986 13-89)
(Contracts ESA-6648/86/NL/PB; ESA-7898/88/NL/PB(SC))
Copyright Avail: NTIS HC/MF A17; EPD, ESTEC, Noordwijk, Netherlands, HC 80 Dutch guilders

N91-22047# Max-Planck-Inst. fuer Radioastronomie, Bonn (Germany, F.R.).
AIRBORNE HETERODYNE RECEIVER FOR THE RANGE 600 GHz TO 3,000 GHz
Hans Peter Roeser, Johannes Schmid-Burgk, Gerhard W. Schwaab, and Ruth U. Titz *In* ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 369-373 (For primary document see N91-21986 13-89)
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34 FLUID MECHANICS AND HEAT TRANSFER

Includes boundary layers; hydrodynamics; fluidics; mass transfer; and ablation cooling.

For related information see also *02 Aerodynamics* and *77 Thermodynamics and Statistical Physics.*

N91-21446*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Facility, Edwards, CA.
A PRELIMINARY EVALUATION OF AN F100 ENGINE PARAMETER ESTIMATION PROCESS USING FLIGHT DATA
Trindel A. Maine, Glenn B. Gilyard, and Heather H. Lambert Washington Aug. 1990 32 p Presented at the 26th AIAA Joint Propulsion Conference, Orlando, FL, 16-18 Jul. 1990 Previously announced in IAA as A90-40559
(NASA-TM-4216; H-1602; NAS 1.15:4216) Avail: NTIS HC/MF A03 CSCL 20D

The parameter estimation algorithm developed for the F100 engine is described. The algorithm is a two-step process. The first step consists of a Kalman filter estimation of five deterioration parameters, which model the off-nominal behavior of the engine during flight. The second step is based on a simplified steady-state model of the compact engine model (CEM). In this step, the control vector in the CEM is augmented by the deterioration parameters estimated in the first step. The results of an evaluation made using flight data from the F-15 aircraft are presented, indicating that the algorithm can provide reasonable estimates of engine variables for an advanced propulsion control law development. Author

N91-21447*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
CFD FOR HYPERSONIC PROPULSION
Louis A. Povinelli 1990 17 p Presented at the Workshop on Hypersonic Flow, Antibes, France, 22-25 Jan. 1990; cosponsored by National Research Inst. for Information and Automation and Group for Advancement of Numerical Engineering Methods
(NASA-TM-103791; E-5689; NAS 1.15:103791) Avail: NTIS HC/MF A03 CSCL 20D

An overview is given of research activity on the application of computational fluid dynamics (CDF) for hypersonic propulsion systems. After the initial consideration of the highly integrated nature of air-breathing hypersonic engines and airframe, attention is directed toward computations carried out for the components of the engine. A generic inlet configuration is considered in order to demonstrate the highly three dimensional viscous flow behavior occurring within rectangular inlets. Reacting flow computations for simple jet injection as well as for more complex combustion chambers are then discussed in order to show the capability of viscous finite rate chemical reaction computer simulations. Finally, the nozzle flow fields are demonstrated, showing the existence of complex shear layers and shock structure in the exhaust plume. The general issues associated with code validation as well as the specific issue associated with the use of CFD for design are discussed. A prognosis for the success of CFD in the design of future propulsion systems is offered. Author

N91-21448*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
ON THE ANOMALY OF VELOCITY-PRESSURE DECOUPLING IN COLLOCATED MESH SOLUTIONS
Sang-Wook Kim (Texas Univ., Arlington.) and Thomas VanOverbeke Mar. 1991 20 p
(NASA-TM-103769; E-6031; NAS 1.15:103769) Avail: NTIS HC/MF A03 CSCL 20D

The use of various pressure correction algorithms originally developed for fully staggered meshes can yield a velocity-pressure decoupled solution for collocated meshes. The mechanism that causes velocity-pressure decoupling is identified. It is shown that the use of a partial differential equation for the incremental pressure eliminates such a mechanism and yields a velocity-pressure coupled solution. Example flows considered are a three dimensional lid-driven cavity flow and a laminar flow through a 90 deg bend square duct. Numerical results obtained using the collocated mesh are in good agreement with the measured data and other numerical results. Author

N91-21449# Argonne National Lab., IL.
HEAT-RATE IMPROVEMENTS OBTAINED WITH THE USE OF ENHANCED TUBES IN SURFACE CONDENSERS
T. Rabas, R. Merring, R. Schaefer, R. Lopez-Gomez, and P. Thors (Wolverine Tube, Inc., Decatur, AL.) 1990 17 p Presented at the EPRI Condenser Technology Conference, Boston, 18 Sep.

1990
(Contract W-31-109-eng-38)
(DE91-006565; CONF-9009230-2) Avail: NTIS HC/MF A03

The overall heat-transfer coefficient can be almost doubled with a change from plain to enhanced tubes when condensing steam on the outside and with water as the tubeside coolant. Three objections most often used are that enhanced tubes (1) have not undergone successful long-term prototypical demonstrations, (2) foul at a faster rate, and (3) are not cost effective. This paper will show that the first objection is not valid and the second and third objections may or may not be valid depending on the site conditions. The Tennessee Valley Authority (TVA) retubed nine power-plant surface condensers with a particular enhanced tube type. These enhanced tubes fall into a general category called spirally indented, corrugated, or rope tubes. The Gallatin Station Unit 1 condenser, which was retubed and went on line in 1980, has not experienced any unique operational problems attributed to the use of this enhanced-tube type. A fouling-rate comparison was made using cleanliness-factor data from the TVA condensers at the Gallatin and Shawnee sites before and after retubing. These data show that the fouling rates are greater than that of plain tubes; however, the performance with the enhanced tubes remained superior for about one year of operation without cleaning. The clean, overall heat transfer coefficients after retubing were increased by factors of 1.25 to 1.6 over the plain-tube values. There may be a heat-rate improvement with enhanced tubes because of the back-pressure reduction resulting from the improved thermal performance. A calculation method is presented in this paper to determine the yearly average heat-rate improvement based on a full-load operation scenario. DOE

N91-21450*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
GEOSIM: A NUMERICAL MODEL FOR GEOPHYSICAL FLUID FLOW SIMULATION
Karen A. Butler, Timothy L. Miller, and Huei-Iin Lu (Universities Space Research Association, Huntsville, AL.) Feb. 1991 34 p
(NASA-TM-103528; NAS 1.15:103528) Avail: NTIS HC/MF A03 CSCL 20D

A numerical model which simulates geophysical fluid flow in a wide range of problems is described in detail, and comparisons of some of the model's results are made with previous experimental and numerical studies. The model is based upon the Boussinesq Navier-Stokes equations in spherical coordinates, which can be reduced to a cylindrical system when latitudinal walls are used near the pole and the ratio of latitudinal length to the radius of the sphere is small. The equations are approximated by finite differences in the meridional plane and spectral decomposition in the azimuthal direction. The user can specify a variety of boundary and initial conditions, and there are five different spectral truncation options. The results of five validation cases are presented: (1) the transition between axisymmetric flow and baroclinic wave flow in the side heated annulus; (2) the steady baroclinic wave of the side heated annulus; (3) the wave amplitude vacillation of the side heated annulus; (4) transition to baroclinic wave flow in a bottom heated annulus; and (5) the Spacelab Geophysical Fluid Flow Cell (spherical) experiment. Author

N91-21451*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
TURBULENT SEPARATED FLOW PAST A BACKWARD-FACING STEP: A CRITICAL EVALUATION OF TWO-EQUATION TURBULENCE MODELS Final Report
S. Thangam (Stevens Inst. of Tech., Hoboken, NJ.) and C. G. Speziale Feb. 1991 28 p Submitted for publication
(Contract NAS1-18605)
(NASA-CR-187532; NAS 1.26:187532; ICASE-91-23) Avail: NTIS HC/MF A03 CSCL 20D

The ability of two-equation models to accurately predict separated flows is analyzed from a combined theoretical and computational standpoint. Turbulent flow past a backward facing step is chosen as a test case in an effort to resolve the variety of conflicting results that were published during the past decade concerning the performance of two-equation models. It is found that the errors in the reported predictions of the k-epsilon model have two major origins: (1) numerical problems arising from inadequate resolution, and (2) inaccurate predictions for normal Reynolds stress differences arising from the use of an isotropic eddy viscosity. Inadequacies in near wall modelling play a substantially smaller role. Detailed calculations are presented which strongly indicate the standard k-epsilon model - when modified with an independently calibrated anisotropic eddy viscosity - can yield surprisingly good predictions for the backstep problem. Author

N91-21452*# Colorado Univ., Boulder. Coll. of Engineering and Applied Science.
CENTER FOR LOW-GRAVITY FLUID MECHANICS AND TRANSPORT PHENOMENA Final Report
D. R. Kassoy and R. L. Sani 31 Mar. 1991 33 p
(Grant NAGw-951)
(NASA-CR-188048; NAS 1.26:188048) Avail: NTIS HC/MF A03 CSCL 20D

Research projects in several areas are discussed. Mass transport in vapor phase systems, droplet collisions and coalescence in microgravity, and rapid solidification of undercooled melts are discussed. Author

N91-21453*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
PROBABILITY DISTRIBUTION FUNCTIONS IN TURBULENT CONVECTION Final Report
S. Balachandar and L. Sirovich (Illinois Univ., Urbana.) Feb. 1991 41 p Submitted for publication
(Contracts NAS1-18605; N00014-86-K-0754)
(NASA-CR-187519; NAS 1.26:187519; ICASE-91-17) Avail: NTIS HC/MF A03 CSCL 20D

Results of an extensive investigation of probability distribution functions (pdfs) for Rayleigh-Benard convection, in hard turbulence regime, are presented. It is shown that the pdfs exhibit a high degree of internal universality. In certain cases this universality is established within two Kolmogorov scales of a boundary. A discussion of the factors leading to the universality is presented. Author

N91-21454*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
PREDICTING CHAOS FOR INFINITE DIMENSIONAL DYNAMICAL SYSTEMS: THE KURAMOTO-SIVASHINSKY EQUATION, A CASE STUDY Final Report
Yiorgos S. Smyrlis and Demetrios T. Papageorgiou (New Jersey Inst. of Tech., Newark.) Feb. 1991 15 p Submitted for publication
(Contracts NAS1-18605; N00014-86-K-0691)
(NASA-CR-187531; NAS 1.26:187531; ICASE-91-22) Avail: NTIS HC/MF A03 CSCL 20D

The results of extensive computations are presented in order to accurately characterize transitions to chaos for the Kuramoto-Sivashinsky equation. In particular, the oscillatory dynamics in a window that supports a complete sequence of period doubling bifurcations preceding chaos is followed. As many as thirteen period doublings are followed and used to compute the Feigenbaum number for the cascade and so enable, for the first time, an accurate numerical evaluation of the theory of universal behavior of nonlinear systems, for an infinite dimensional dynamical system. Furthermore, the dynamics at the threshold of chaos exhibit a fractal behavior which is demonstrated and used to compute a universal scaling factor that enables the self-similar continuation of the solution into a chaotic regime. Author

N91-21455*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
SINGULARITIES IN WATER WAVES AND RAYLEIGH-TAYLOR INSTABILITY Final Report
S. Tanveer Feb. 1991 90 p Submitted for publication

(Contract NAS1-18605; NSF DMS-87-13246)
(NASA-CR-187530; NAS 1.26:187530; ICASE-91-21) Avail: NTIS HC/MF A05 CSCL 20D

Singularities in inviscid two-dimensional finite-amplitude water waves and inviscid Rayleigh-Taylor instability are discussed. For the deep water gravity waves of permanent form, through a combination of analytical and numerical methods, results describing the precise form, number, and location of singularities in the unphysical domain as the wave height is increased are presented. It is shown how the information on the singularity in the unphysical region has the same form as for deep water waves. However, associated with such a singularity is a series of image singularities at increasing distances from the physical plane with possibly different behavior. Furthermore, for the Rayleigh-Taylor problem of motion of fluid over a vacuum and for the unsteady water wave problem, integro-differential equations valid in the unphysical region are derived, and how these equations can give information on the nature of singularities for arbitrary initial conditions is shown. Author

N91-21456*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
UNIFORM HIGH ORDER SPECTRAL METHODS FOR ONE AND TWO DIMENSIONAL EULER EQUATIONS Final Report
Wei Cai and Chi-Wang Shu (Brown Univ., Providence, RI.) Mar. 1991 53 p Submitted for publication
(Contract NAS1-18605; NAG1-1145; NSF ASC-90-05874; NSF DMS-88-10150; AF-AFOSR-0093-90)
(NASA-CR-187535; NAS 1.26:187535; ICASE-91-26) Avail: NTIS HC/MF A04 CSCL 20D

Uniform high order spectral methods to solve multi-dimensional Euler equations for gas dynamics are discussed. Uniform high order spectral approximations with spectral accuracy in smooth regions of solutions are constructed by introducing the idea of the Essentially Non-Oscillatory (ENO) polynomial interpolations into the spectral methods. The authors present numerical results for the inviscid Burgers' equation, and for the one dimensional Euler equations including the interactions between a shock wave and density disturbance, Sod's and Lax's shock tube problems, and the blast wave problem. The interaction between a Mach 3 two dimensional shock wave and a rotating vortex is simulated. Author

N91-21457*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
DOMAIN DECOMPOSITION METHODS IN COMPUTATIONAL FLUID DYNAMICS Final Report
William D. Gropp and David E. Keyes (Yale Univ., New Haven, CT.) Feb. 1991 25 p Submitted for publication
(Contract NAS1-18605)
(NASA-CR-187529; ICASE-91-20; NAS 1.26:187529) Avail: NTIS HC/MF A03 CSCL 20D

The divide-and-conquer paradigm of iterative domain decomposition, or substructuring, has become a practical tool in computational fluid dynamic applications because of its flexibility in accommodating adaptive refinement through locally uniform (or quasi-uniform) grids, its ability to exploit multiple discretizations of the operator equations, and the modular pathway it provides towards parallelism. These features are illustrated on the classic model problem of flow over a backstep using Newton's method as the nonlinear iteration. Multiple discretizations (second-order in the operator and first-order in the preconditioner) and locally uniform mesh refinement pay dividends separately, and they can be combined synergistically. Sample performance results are included from an Intel iPSC/860 hypercube implementation. Author

N91-21458*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
APPLICATION OF COMPUTATIONAL FLUID DYNAMICS IN HIGH SPEED AEROPROPULSION
Louis A. Povinelli 1991 5 p Proposed for presentation at the 13th IMACS World Congress on Computation and Applied Mathematics, Dublin, Ireland, 22-26 Jul. 1991; cosponsored by International Federation for Automatic Control, International Federation for Information Processing,
(NASA-TM-103780; E-6053; NAS 1.15:103780) Avail: NTIS HC/MF A01 CSCL 20D

The application is described of computational fluid dynamics (CFD) to a hypersonic propulsion system. An overview of the problems associated with a propulsion system of this type is presented, highlighting the special role that CFD plays in the design of said systems. Author

N91-21459*# Aerometrics, Inc., Mountain View, CA.
AN EXPERIMENTAL INVESTIGATION OF CIRCULATION CONTROL FLOW FIELDS USING HOLOGRAPHIC INTERFEROMETRY
William D. Bachalo Oct. 1982 70 p Sponsored by NASA, Ames Research Center
(NASA-CR-166482; NAS 1.26:166482) Avail: NTIS HC/MF A04 CSCL 20D

Experiments are presented which were conducted on flow fields produced by a circulation control airfoil utilizing the Coanda effect at the trailing edge. The application of holographic interferometry to obtain both visualization and quantitative data on the flow field about a circulation control airfoil at transonic flow speed is covered. A brief description of the flow model and measurement techniques is given. The data reduction procedure, results, and interpretation are presented. The results have provided a good deal of information on the character of the flow field, particularly in the neighborhood of the trailing edge. As to the airfoil design, it is apparent that improved performance can be achieved if jet detachment is delayed. Another design improvement would involve the development of an optimum trailing-edge shape for the expected operating Mach and Reynolds number ranges. B.G.

N91-21460# Royal Aerospace Establishment, Farnborough (England).
A SIMPLE MODEL VORTEX FLOW PAST A SLENDER ELLIPTIC CONE AT INCIDENCE
M. Pidd, J. Pinkney, and J. H. B. Smith 8 Oct. 1990 37 p
(RAE-TM-Aero-2197; BR115687; ETN-91-99006; AD-A230332)
Copyright Avail: NTIS HC/MF A03

The single line vortex model of the separated flow past a slender pointed body of revolution at incidence is extended to elliptic cones, within the framework of slender body theory, and maintaining lateral symmetry in the flow. An analytical solution is found for the limiting behavior of the model when the vortices are weak. The angle of incidence above which solutions exist is found as a function of the axis ratio of the elliptic cross section and the postulated location of the separation lines. ESA

N91-21461# Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Mechanical Engineering.
EXPERIMENTAL AND THEORETICAL STUDIES OF VERTICAL ANNULAR LIQUID JETS
J. I. Ramos 24 Feb. 1990 77 p
(Contract DE-FG02-86ER-13597)
(DE91-008042; DOE/ER-13597/T3) Avail: NTIS HC/MF A05

Theoretical studies are described of vertical annular jets, the conditions are determined under which vertical jets form an enclosed volume which can be used as a chemical reactor, the influence is assessed of the nozzle gap width, nozzle geometry, pressure difference across the annular jet, and Froude, Weber and Reynolds numbers on the annular jet's covergence length, and the mass absorption rate is determined by the liquid jet as a function of the aforementioned parameters and Peclet number. Both analytical and numerical solutions of the governing equations are presented, and the ranges of the parameters for which the analytical solutions are valid are determined. In addition, the numerical solution of the governing equations are compared with experimental data, and the response of the liquid curtain to fluctuations in the mass flow rate at the nozzle exit, injection pressure in the volume enclosed by the annular jet, and pressure fluctuations, is determined numerically. The collapse of annular

jets due to mass absorption is also determined as a function of the Froude, Weber and Peclet numbers, solubilities of the gas in the liquid, pressure and nozzle geometry. Analytical and numerical studies on annular jets in zero gravity, and a theory of liquid membranes are also discussed. DOE

N91-21462# Los Alamos National Lab., NM.
LAYER TRACKING ASYMPTOTICS AND DOMAIN DECOMPOSITION
D. L. Brown, R. C. Y. Chin, G. W. Hedstrom, and T. A. Manteuffel (Colorado Univ., Denver.) 1990 18 p Presented at the ICASE Workshop: Heterogeneous Boundary Condition, Hampton, 26-28 Sep. 1990
(Contracts W-7405-eng-36; W-7405-eng-48)
(DE91-008593; LA-UR-91-589; CONF-9009351-1) Avail: NTIS HC/MF A03

A preliminary report is presented on the work on the tracking of internal layers in a singularly-perturbed convection-diffusion equation. It is shown why such tracking may be desirable, and it is also shown how to do it using domain decomposition based on asymptotic analysis. DOE

N91-21463*# Imperial Coll. of Science and Technology, London (England). Dept. of Aeronautics.
FINITE ELEMENT METHODS OF ANALYSIS FOR 3D INVISCID COMPRESSIBLE FLOWS Final Report, 1 Dec. 1989 - 30 Nov. 1990
Jaime Peraire 30 Nov. 1990 42 p
(Contract NCCw-10)
(NASA-CR-186271; NAS 1.26:186271) Avail: NTIS HC/MF A03 CSCL 20D

The applicants have developed a finite element based approach for the solution of three-dimensional compressible flows. The procedure enables flow solutions to be obtained on tetrahedral discretizations of computational domains of complex form. A further development was the incorporation of a solution adaptive mesh strategy in which the adaptivity is achieved by complete remeshing of the solution domain. During the previous year, the applicants were working with the Advanced Aerodynamics Concepts Branch at NASA Ames Research Center with an implementation of the basic meshing and solution procedure. The objective of the work to be performed over this twelve month period was the transfer of the adaptive mesh technology and also the undertaking of basic research into alternative flow algorithms for the Euler equations on unstructured meshes. Author

N91-21464# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Fluid Dynamics Panel.
APPLICATION OF MESH GENERATION TO COMPLEX 3-D CONFIGURATIONS
Joseph L. Steger and W. Schmidt, ed. (Messerschmitt-Boelkow-Blohm G.m.b.H., Munich, Germany, F.R.) 1991 18 p Presented at the AGARD Fluid Dynamics Panel Specialists Meeting, Loen, Norway, 24-25 May 1989
(AGARD-AR-268; ISBN-92-835-0608-1) Copyright Avail: NTIS HC/MF A03; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

The papers presented at the AGARD Fluid Dynamics Panel Specialists' Meeting are summarized and evaluated. Some general comments regarding progress in mesh generation are provided and the important role of grid generation in providing accurate aerodynamic simulations is underscored. Recommendations and opinions are offered regarding the use of both structured and unstructured grids for CFD applications. Author

N91-21465# European Space Agency, Paris (France).
TRANSITION AND TURBULENCE
Henri Werle (Office National d'Etudes et de Recherches Aerospatiales, Paris, France) Nov. 1990 119 p Transl. into ENGLISH of Transitions et Turbulence (Visualisations Hydrodynamiques) (Paris, France, ONERA), 1987 Original language document was announced as N89-29722 (ESA-TT-1219; ONERA-NT-1987-7; ETN-91-98975) Avail: NTIS HC/MF A06

Using the very extensive range of Reynolds numbers (10,000 to 1,000,000) of the TH2 water tunnel at Chatillon (France) laminar turbulent transition phenomena of flow around initially smooth models (instabilities of the Tollmien-Schlichting type, isolated spots, generalized turbulence) were studied systematically by visualizations and with methods previously developed in the TH1 water tunnel. These tests concern a wide variety of models: flat plate type models (smooth or grooved, with curved afterbody or right base); cylindrical pod type models (smooth or grooved, with curved afterbody or plane base); and models of various shapes. ESA

N91-21466# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.). Abt. Zellenaerodynamik.
FLOW VISUALIZATION ION HELICOPTER BLADES USING ACENAPHTHEN
Claas-Hinrik Rohardt Jul. 1990 42 p In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-1255)
(DLR-FB-90-37; ISSN-0171-1342; ETN-91-99032) Avail: NTIS HC/MF A03; DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 11.50 DM

An experiment for flow visualization of boundary layer character on a helicopter blade under operational conditions is carried out. Comparisons with two dimensional computations were discussed to determine transition locations. The flow visualization with acenaphthene was chosen because of its speed and ease in evaluating the laminar turbulent transition. It is shown that considerably longer laminar flow are possible. ESA

N91-21467# Aeronautical Research Inst. of Sweden, Stockholm. Dept. of Aerodynamics.
ON THE MAPPING PROPERTIES OF BOUNDARY INTEGRAL OPERATORS FOR NAVIER-STOKES LIKE EQUATIONS
Peter Wilde Nov. 1990 23 p Sponsored by National Swedish Board for Technical Development, Stockholm and Defence Material Administration, Stockholm, Sweden
(FFA-TN-1989-41; ETN-91-99039) Avail: NTIS HC/MF A03

Single and double layer potentials for the Stokes and the time discretized Navier-Stokes equations are studied. The jump relations are derived and the mapping properties for the corresponding boundary integral operators are studied. ESA

N91-21468# Aeronautical Research Inst. of Sweden, Stockholm. Dept. of Aerodynamics.
EXISTENCE AND UNIQUENESS RESULTS FOR PROBLEMS ARISING IN CONNECTION WITH THE INCOMPRESSIBLE NAVIER-STOKES EQUATIONS
Peter Wilde Nov. 1990 31 p Sponsored by National Swedish Board for Technical Development, Stockholm and Defence Material Administration, Stockholm, Sweden
(FFA-TN-1989-43; ETN-91-99040) Avail: NTIS HC/MF A03

Boundary value and coupling problems for a system of partial differential equations obtained by applying the Rothe method to the incompressible Navier-Stokes equations are studied. Uniqueness theorems for the coupling and for the three fundamental boundary value problems in interior and exterior domains are obtained. Existence theorems are obtained by applying the first part of Fredholm's alternative to modified boundary integral equations obtained from an ansatz approach as well as from representation theorems. Corresponding boundary integral equations of the first kind are studied. Some formulae for the calulation of the drag are derived. ESA

N91-21469# Aeronautical Research Inst. of Sweden, Stockholm. Dept. of Aerodynamics.
SOME TREATMENTS ON BOUNDARY CONDITIONS FOR QUASI ONE-DIMENSIONAL EULER EQUATIONS
Hu Jiasen Sep. 1990 20 p Sponsored by National Swedish

Board for Technical Development, Stockholm
(FFA-TN-1990-36; ETN-91-99045) Avail: NTIS HC/MF A03

Three different methods to specify the boundary conditions for quasi one-dimensional Euler equations are presented. A Euler solver with the methods for the isenthalpic one-dimensional nozzle flow was developed. The code is designed to predict all typical flow regimes and was applied to seven model problems. The results obtained are compared with analytical solutions and good agreements are achieved. ESA

N91-21470*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
CHARACTERISTIC EDDY DECOMPOSITION OF TURBULENCE IN A CHANNEL
Parviz Moin and Robert D. Moser Mar. 1991 50 p Previously announced in IAA as A89-37941
(NASA-TM-100065; A-88081; NAS 1.15:100065) Avail: NTIS HC/MF A03 CSCL 20D

The proper orthogonal decomposition technique (Lumley's decomposition) is applied to the turbulent flow in a channel to extract coherent structures by decomposing the velocity field into characteristic eddies with random coefficients. In the homogeneous spatial directions, a generaliztion of the shot-noise expansion is used to determine the characteristic eddies. In this expansion, the Fourier coefficients of the characteristic eddy cannot be obtained from the second-order statistics. Three different techniques are used to determine the phases of these coefficients. They are based on: (1) the bispectrum, (2) a spatial compactness requirement, and (3) a functional continuity argument. Results from these three techniques are found to be similar in most respects. The implications of these techniques and the shot-noise expansion are discussed. The dominant eddy is found to contribute as much as 76 percent to the turbulent kinetic energy. In both 2D and 3D, the characteristic eddies consist of an ejection region straddled by streamwise vortices that leave the wall in the very short streamwise distance of about 100 wall units. Author

N91-21471*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
ESTIMATES OF THERMOCHEMICAL RELAXATION LENGTHS BEHIND NORMAL SHOCK WAVES RELEVANT TO MANNED LUNAR AND MARS RETURN MISSIONS, THE AEROASSIST FLIGHT EXPERIMENT, AND MARS ENTRY
John T. Howe Feb. 1991 20 p
(NASA-TM-102879; A-91003; NAS 1.15:102879) Avail: NTIS HC/MF A03 CSCL 20D

Thermochemical relaxation distances behind the strong normal shock waves associated with vehicles that enter the Earth atmosphere upon returning from a manned lunar or Mars mission are estimated. The relaxation distances for a Mars entry are estimated as well, in order to highlight the extent of the relaxation phenomena early in currently envisioned space exploration studies. The thermochemical relaxation length for the Aeroassist Flight Experiment is also considered. These estimates provide an indication as to whether finite relaxation needs to be considered in subsequent detailed analyses. For the Mars entry, relaxation phenomena that are fully coupled to the flow field equations are used. The relaxation-distance estimates can be scaled to flight conditions other than those discussed. Author

N91-21472* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
METHOD AND APPARATUS FOR DETECTING LAMINAR FLOW SEPARATION AND REATTACHMENT Patent
John P. Stack, inventor (to NASA) and Sivaramakrishnan M. Mangalam, inventor (to NASA) (Analytical Services and Materials, Inc., Hampton, VA.) 26 Jun. 1990 11 p Filed 4 May 1989 Division of US-Patent-Appl-SN-203178, filed 7 Jun. 1988
(NASA-Case-LAR-13952-2-SB; US-Patent-4,936,146; US-Patent-Appl-SN-348223; US-Patent-Appl-SN-203178; US-Patent-Class-73-432.1; Int-Patent-Class-G01F-1/00) Avail: US Patent and Trademark Office CSCL 20D

The invention is a method and apparatus for simultaneously detecting laminar separation and reattachment of a fluid stream such as an airstream from and to the upper surface of an airfoil by simultaneously sensing and comparing a plurality of output signals. Each signal represents the dynamic shear stress at one of an equal number of sensors spaced along a straight line on the surface of the airfoil that extends parallel to the airstream. The output signals are simultaneously compared to detect the sensors across which a reversal in phase of said output signal occurs, said detected sensors being in the region of laminar separation or reattachment.
Official Gazette of the U.S. Patent and Trademark Office

N91-21473* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
HEAT TUBE DEVICE Patent
Mukesh K. Khattar, inventor (to NASA) (Florida Solar Energy Center, Cape Canaveral.) 20 Nov. 1990 9 p Filed 31 Jan. 1990
(NASA-Case-KSC-11395-1-CU; US-Patent-4,971,139; US-Patent-Appl-SN-473065; US-Patent-Class-165-86; US-Patent-Class-165-96; US-Patent-Class-165-104.14; US-Patent-Class-62-90; US-Patent-Class-62-333; US-Patent-Class-62-384; Int-Patent-Class-F28D-15/02) Avail: US Patent and Trademark Office CSCL 20D

The present invention discloses a heat tube device through which a working fluid can be circulated to transfer heat to air in a conventional air conditioning system. The heat tube device is disposable about a conventional cooling coil of the air conditioning system and includes a plurality of substantially U-shaped tubes connected to a support structure. The support structure includes members for allowing the heat tube device to be readily positioned about the cooling coil. An actuatable adjustment device is connected to the U-shaped tubes for allowing, upon actuation thereof, for the heat tubes to be simultaneously rotated relative to the cooling coil for allowing the heat transfer from the heat tube device to air in the air conditioning system to be selectively varied. Official Gazette of the U.S. Patent and Trademark Office

N91-21474# Washington Univ., Seattle. Dept. of Applied Mathematics.
GENERAL THREE-DIMENSIONAL DISTURBANCES TO INVISCID COUETTE FLOW
W. O. Criminale, B. Long, and Mei Zhu Dec. 1990 22 p
(Contract DE-FG06-88ER-25061)
(DE91-009593; DOE/ER-25061/9; TR-90-9) Avail: NTIS HC/MF A03

The general solution to the linearized equations governing three-dimensional disturbances to inviscid Couette flow has been obtained. This result extends the Orr solution to initial conditions that do not consist of a single Fourier sine component in the cross-stream coordinate and a plane wave in the streamwise/spanwise coordinates. The time evolution of a measure of disturbance energy for some specific pulsed initial conditions is examined, and is concluded that, while the rapid algebraic growth to large amplitude followed by decay exemplified by the Orr solution can be of importance for individual cross-stream Fourier components, more realistic initial conditions which in general consist of the sum of an infinite number of components often display uniform decay to zero amplitude. However, an interesting example is described in which one positive definite measure of disturbance amplitude remains constant, yet the stream-wise/spanwise velocity components grow linearly in time if the initial disturbance is three-dimensional. DOE

N91-21475# State Univ. of New York, Stony Brook. Dept. of Chemistry.
STUDIES IN CLUSTERING THEORY Final Report
George Stell 1990 5 p
(Contract N00014-90-J-1731)
(AD-A230967) Avail: NTIS HC/MF A01 CSCL 20/4

In recent years the properties of percolation models have been studied intensively. The purpose of our project was to develop a general theory of percolation and clustering between particles

of arbitrary size and shape, with arbitrary correlations between them. The goal of such a theory includes the treatment of continuum percolation as well as a novel treatment of lattice percolation. We made substantial progress toward this goal. The quantities basic to a description of clustering, the mean cluster size, mean number of clusters, etc., were developed. Concise formulas were given for the terms in such series, and proved, at least for sufficiently low densities, that the series are absolutely convergent. These series can now be used to construct Pade approximants that will allow one to probe the percolation transition. A scaled-particle theory of percolation was developed which gives analytic approximants for the mean number of clusters in a large class of two and three dimensional percolation models. Although this quantity is essential in many applications, e.g., explaining colligative properties, and interpreting low-angle light-scattering data, no systematic studies of it have been done before this work. Recently carried out detailed computer simulations show that the mean number of clusters is given to high accuracy by several of there approximations. Extensions of this work will allow calculation of the complete cluster size distribution. GRA

N91-21476# Battelle Memorial Inst., Richland, WA.
FUNDAMENTAL INVESTIGATION OF MICELLES AND MICROEMULSIONS IN SUPERCRITICAL FLUIDS Final Report, 24 Sep. 1987 - 23 Sep. 1990
John Fulton and Richard D. Smith 12 Nov. 1990 13 p
(Contract DAAL03-87-K-0137)
(AD-A231073; ARO-24974.13-CH) Avail: NTIS HC/MF A03
CSCL 20/4

The goal of this 3-year program has been to characterize the physicochemical properties of microemulsions formed in supercritical fluids so as to determine their potential relevance to Army applications. Included in this program has been an investigation of extraction processes utilizing microemulsions formed in supercritical fluids. Supercritical fluid microemulsions may ultimately be applied to a range of problems involving waste disposal, decontamination technologies, solute extractions and chemical reaction processes. This program has involved two related major activities: (1) exploration of selected ternary and quaternary systems composed of surfactant (and possibly a co-surfactant), water and supercritical fluids to characterize their physicochemical properties using analytical methods such as conductivity, quasi-elastic light scattering (QLS) and the UV-visible and FTIR spectroscopy of probe molecules within the microemulsion; and (2) study of the properties of microemulsions formed in supercritical fluids relevant to the enhancement of extraction and reaction rates. GRA

N91-21477# California Inst. of Tech., Pasadena. Dept. of Applied Mathematics.
RESEARCH IN NONLINEAR WATER WAVES Quarterly Letter Progress Report, 1 Oct. - 31 Dec. 1990
P. G. Saffman 2 Jan. 1991 2 p
(Contract N00014-89-J-1164)
(AD-A231205) Avail: NTIS HC/MF A01 CSCL 20/4

Work has continued during the quarter on the dynamical effects of a thin shear layer on the structure and stability of finite amplitude water waves. One problem of interest is the possibility of an explosive instability which occurs when there is resonance between waves of opposite signature. The signature can be thought of as the energy of the wave, and the explosive instability is an interaction between waves with positive and negative energy. Work was started on the effect of a thin, vorticity containing shear layer in the water on the Kelvin-Helmholtz and Miles instabilities of the air flow over water. The team is in the process of formulating the equations and are now considering efficient methods of solution and deciding upon the relevant parts of parameter space to search. Preliminary calculations with a stick profile suggest that some rather interesting results may be obtained. In order to determine the effect of a thin vortical layer, it is necessary to study first the classical case of wind over water in the absence of vorticity in the water. GRA

N91-21478# North Carolina State Univ., Raleigh. Dept. of Mechanical and Aerospace Engineering.
GRADUATE FELLOWSHIP IN HYPERSONICS Final Report, Jul. 1986 - Sep. 1990
D. S. McRae and Paul D. Orkwis 30 Nov. 1990 10 p
(Contract DAAL03-86-G-0039)
(AD-A231263; ARO-23764.3-EG-F) Avail: NTIS HC/MF A02
CSCL 20/4

Research was performed to develop innovative means of computing flow over sustainer projectiles at high speed. A code was developed using Newton iteration applied to the steady Navier-Stokes equations. Roe's upwind flux difference splitting was used for spatial discretization. Second order accurate values of the Riemann variables were obtained by Spekreijses interpolation procedure with Van Albada's limiter used to reduce spurious oscillations in the results. The Jacobian Derivatives and the code necessary to compute the Jacobian elements were generated by use of the symbolic manipulation code MACSYMA. The Boeing package RSLIB was used to invert the Jacobian matrix. Computational results were obtained for flat plates, flat plate-ramp, and ogive-tangent-cylinder configurations at Mach numbers ranging from 2 to 14.1. These cases contained shock on shock interactions, viscous layer separations, and turbulent boundary layer transitions. Covergence was obtained in 15 to 200+ iterations. Results agreed well with experiment or other computation and demonstrated that Newton iteration can produce results for complex high speed flows with shock waves. GRA

N91-21479# New York Univ., New York. Courant Inst. of Mathematical Sciences.
CONVERGENCE OF THE POINT VORTEX METHOD FOR THE 3-D EULER EQUATIONS
Thomas Y. Hou and John Lowengrub 1990 17 p
(Grant AF-AFOSR-0352-86)
(AD-A231285) Avail: NTIS HC/MF A03 CSCL 20/4

Consistency, stability, and convergence of a point vortex approximation to the 3-D incompressible Euler equations with smooth solutions. The 3-D algorithm considered is similar to the corresponding 3-D vortex are proved blob algorithm introduced by Beale and Majda; The discretization error is second-order accurate. Then the method is stable in l sup p norm for the particle trajectories and in w sup -1,p norm for discrete vorticity. Consequently, the method converges up to any time for which the Euler equations have a smooth solution. One immediate application of the convergence result is that the vortex filament method without smoothing also converges. GRA

N91-21480# Brown Univ., Providence, RI.
ON THE SLOWNESS OF PHASE BOUNDARY MOTION IN ONE SPACE DIMENSION
Lia Bronsard 1990 15 p Submitted for publication
(Contracts N00014-88-K-0279; F49620-87-C-0065)
(AD-A231286) Avail: NTIS HC/MF A03 CSCL 20/4

The limiting behavior is studied of the solution of a certain equation with a Neumann boundary condition or an appropriate Dirichlet condition. The analysis is based on energy methods. It is assumed that the initial data has a transition layer structure. GRA

N91-21481# Software and Engineering Associates, Inc., Carson City, NV.
BOUNDARY LAYER STUDY. PHASE 4: EXPERIMENTAL VALIDATION TEST PLAN Final Report, Jul. 1986 - Feb. 1990
H. Kehtarnavaz and D. E. Coats Nov. 1990 158 p
(Contract F04611-86-C-0055)
(AD-A231342; AL-TR-90-043-Phase-4) Avail: NTIS HC/MF A08
CSCL 21/8

The trend towards very large area ratio nozzles, which result in performance gains for space propulsion applications, has increased the need for detailed knowledge of the momentum losses due to nozzle viscous effects (i.e., boundary layer). These losses degrade overall system performance, such as increasing system weight, decreasing useful payload weight, and/or decreasing

effective system range. Another important factor in designing propulsive nozzles is the detailed knowledge of heat transfer at the wall for regeneratively cooled walls and/or material performance. Phase 4 (described in this report) consists of preparing an experimental test plan, which, if executed, would validate computational techniques used in evaluating propulsion performance losses due to boundary layers in rocket nozzles. The importance of the loss and the basis for the experimental work are established. Experimental techniques are also reviewed. Visits to numerous experimental facilities are described along with recommendations from these facilities. Finally, recommendations as to the diagnostic techniques of choice are made. GRA

N91-21482# Software and Engineering Associates, Inc., Carson City, NV.
BOUNDARY LAYER STUDY Final Report, Jul. 1986 - Feb. 1990
D. E. Coats, D. R. Berker, and S. S. Dunn Nov. 1990 128 p
(Contract F04611-86-C-0055)
(AD-A231343; AL-TR-90-040) Avail: NTIS HC/MF A07 CSCL 21/8

This work produced new and better tools for predicting delivered nozzle performance for very high area ratio liquid propellant rocket engines. The motivation for this work is the current interest in space propulsion systems and the high impact that delivered performance has on system design. Design margins can be significantly reduced if the accuracy and reliability of predictive procedures is improved. Two computer programs were developed under this effort. The first of these programs was an extension to the JANNAF standard TDK/BLM code. The second code, called VIPER, was a Parabolized Navier-Stokes solver with finite rate chemistry. An experimental plan to validate the predictive capabilities of the two codes was also formulated. Comparison of both TDK/BLM and VIPER to available data shows excellent agreement. GRA

N91-21483# Defence Research Establishment Suffield, Ralston (Alberta).
FINITE DIFFERENCE FORM OF THE COMPRESSIBLE BOUNDARY LAYER EQUATIONS IN GENERALIZED CURVILINEAR COORDINATES
Denis Bergeron Dec. 1990 29 p
(AD-A231386; DRES-SM-1348) Avail: NTIS HC/MF A03 CSCL 20/4

The development of a finite difference form of the unsteady boundary layer equations for two dimensional flow is presented. The equations are written in body-conformal coordinates, non-dimensionalized, transformed to a generalized curvilinear coordinate system, and expanded to yield equations suitable for use in a tridiagonal solver. The boundary conditions are also presented. GRA

N91-21484# Battelle Memorial Inst., Columbus, OH.
VARIATIONAL METHOD IN THE STATISTICAL THEORY OF TURBULENCE Final Report, Jan. 1988 - Jun. 1990
G. Domokos, S. Kovesi-Domokos, and C. K. Zoltani Jan. 1991 37 p
(AD-A231621; BRL-TR-3192) Avail: NTIS HC/MF A03 CSCL 20/4

A new approach to the calculation of turbulent flows is presented. Variational principles are introduced into the statistical theory of turbulence enabling the determination of correlation functions by extremizing certain functionals. To demonstrate the efficiency of the technique a sample calculation of a mean flow profile and certain two point correlation functions of a cylindrically symmetric free jet were carried out using the Rayleigh-Ritz method. A judicious choice of the trial functions leads to the determination of the correlation functions with a modest amount of computation. The results are in reasonable agreement with experimental data. GRA

N91-21063*# California Univ., Davis. Dept. of Mechanical, Aeronautical, and Materials Engineering.
THOUGHTS ON THE CHIMERA METHOD OF SIMULATION OF THREE-DIMENSIONAL VISCOUS FLOW
Joseph L. Steger *In* NASA, Lewis Research Center, Computational Fluid Dynamics Symposium on Aeropropulsion Jan. 1991 p 1-10 (For primary document see N91-21062 13-02)
Avail: NTIS HC/MF A99; 10 functional color pages CSCL 20D

N91-21066*# Massachusetts Inst. of Tech., Cambridge.
COMPUTATIONAL STUDY OF THREE DIMENSIONAL VISCOUS FLOW THROUGH A TURBINE CASCADE USING A MULTI-DOMAIN SPECTRAL TECHNIQUE
Earl W. Renaud and Choon S. Tan *In* NASA, Lewis Research Center, Computational Fluid Dynamics Symposium on Aeropropulsion Jan. 1991 p 41-53 (For primary document see N91-21062 13-02)
(Grants NAG3-660; AF-AFOSR-0288-85)
Avail: NTIS HC/MF A99; 10 functional color pages CSCL 20D

N91-21067*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
A FINITE-DIFFERENCE, FREQUENCY-DOMAIN NUMERICAL SCHEME FOR THE SOLUTION OF THE LINEARIZED UNSTEADY EULER EQUATIONS
James R. Scott and Hafiz M. Atassi (Notre Dame Univ., IN.) *In its* Computational Fluid Dynamics Symposium on Aeropropulsion Jan. 1991 p 55-104 (For primary document see N91-21062 13-02)
Avail: NTIS HC/MF A99; 10 functional color pages CSCL 20D

N91-21068*# Cincinnati Univ., OH.
A PRESSURE FLUX-SPLIT TECHNIQUE FOR COMPUTATION OF INLET FLOW BEHAVIOR
H. S. Pordal, P. K. Khosla, and S. G. Rubin *In* NASA, Lewis Research Center, Computational Fluid Dynamics Symposium on Aeropropulsion Jan. 1991 p 105-117 (For primary document see N91-21062 13-02)
(Contract NAG3-716; F49620-85-C-0027)
Avail: NTIS HC/MF A99; 10 functional color pages CSCL 20D

N91-21069*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
SIMULATION OF TURBOMACHINERY FLOWS
John J. Adamczyk *In its* Computational Fluid Dynamics Symposium on Aeropropulsion Jan. 1991 p 119-126 (For primary document see N91-21062 13-02)
Avail: NTIS HC/MF A99; 10 functional color pages CSCL 20D

N91-21070*# Rockwell International Corp., Canoga Park, CA. Rocketdyne Div.
NUMERICAL SOLUTIONS OF 2-D MULTI-STAGE ROTOR/STATOR UNSTEADY FLOW INTERACTIONS
R.-J. Yang and S.-J. Lin *In* NASA, Lewis Research Center, Computational Fluid Dynamics Symposium on Aeropropulsion Jan. 1991 p 127-142 Original contains color illustrations (For primary document see N91-21062 13-02)
(Contract NAS8-40000)
Avail: NTIS HC/MF A99; 10 functional color pages CSCL 20D

N91-21071*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
TRANSONIC CASCADE FLOW CALCULATIONS USING NON-PERIODIC C-TYPE GRIDS
Andrea Arnone, Meng-Sing Liou, and Louis A. Povinelli *In its* Computational Fluid Dynamics Symposium on Aeropropulsion Jan. 1991 p 143-162 (For primary document see N91-21062 13-02)
(NASA Order C-99066-G)
Avail: NTIS HC/MF A99; 10 functional color pages CSCL 20D

N91-21072*# Pennsylvania State Univ., University Park. Dept. of Aerospace Engineering.
COMPUTATION OF SUPERSONIC AND LOW SUBSONIC CASCADE FLOWS USING AN EXPLICIT NAVIER-STOKES TECHNIQUE AND THE KAPPA-EPSILON TURBULENCE MODEL
R. F. Kunz and B. Lakshminarayana *In* NASA, Lewis Research Center, Computational Fluid Dynamics Symposium on Aeropropulsion Jan. 1991 p 163-201 (For primary document see N91-21062 13-02)
(Contract DAAL03-86-G-0044)
Avail: NTIS HC/MF A99; 10 functional color pages CSCL 20D

N91-21073*# Michigan Univ., Ann Arbor. Dept. of Aerospace Engineering.
FLUX-VECTOR SPLITTING FOR THE 1990S
Bram vanLeer *In* NASA, Lewis Research Center, Computational Fluid Dynamics Symposium on Aeropropulsion Jan. 1991 p 203-214 (For primary document see N91-21062 13-02)
Avail: NTIS HC/MF A99; 10 functional color pages CSCL 20D

N91-21074*# Cleveland State Univ., OH. Dept. of Mathematics.
ON THE APPLICATION OF ENO SCHEME WITH SUBCELL RESOLUTION TO CONSERVATION LAWS WITH STIFF SOURCE TERMS
Shih-Hung Chang *In* NASA, Lewis Research Center, Computational Fluid Dynamics Symposium on Aeropropulsion Jan. 1991 p 215-225 (For primary document see N91-21062 13-02)
(NASA Order C-99066-G)
Avail: NTIS HC/MF A99; 10 functional color pages CSCL 20D

N91-21075*# Akron Univ., OH.
COST-EFFECTIVE ACCURATE COARSE-GRID METHOD FOR HIGHLY CONVECTIVE MULTIDIMENSIONAL UNSTEADY FLOWS
B. P. Leonard and H. S. Niknafs *In* NASA, Lewis Research Center, Computational Fluid Dynamics Symposium on Aeropropulsion Jan. 1991 p 227-240 (For primary document see N91-21062 13-02)
Avail: NTIS HC/MF A99; 10 functional color pages CSCL 20D

N91-21076*# Florida Univ., Gainesville. Dept. of Aerospace Engineering, Mechanics and Engineering Science.
CHOICE OF VELOCITY VARIABLES FOR COMPLEX FLOW COMPUTATION
W. Shyy and G. C. Chang (Chung Shan Inst. of Science and Technology, Taiwan) *In* NASA, Lewis Research Center, Computational Fluid Dynamics Symposium on Aeropropulsion Jan. 1991 p 241-257 (For primary document see N91-21062 13-02)
Avail: NTIS HC/MF A99; 10 functional color pages CSCL 20D

N91-21077*# Pennsylvania State Univ., University Park.
DISTRIBUTED MINIMAL RESIDUAL (DMR) METHOD FOR ACCELERATION OF ITERATIVE ALGORITHMS
Seungsoo Lee and George S. Dulikravich *In* NASA, Lewis Research Center, Computational Fluid Dynamics Symposium on Aeropropulsion Jan. 1991 p 259-280 (For primary document see N91-21062 13-02)
Avail: NTIS HC/MF A99; 10 functional color pages CSCL 20D

N91-21078*# Pennsylvania State Univ., University Park. Dept. of Aerospace Engineering.
A PRESSURE BASED METHOD FOR THE SOLUTION OF VISCOUS INCOMPRESSIBLE TURBOMACHINERY FLOWS
Garth Victor Hobson and B. Lakshminarayana *In* NASA, Lewis Research Center, Computational Fluid Dynamics Symposium on Aeropropulsion Jan. 1991 p 281-309 (For primary document see N91-21062 13-02)
(Grants NsG-3266; NAC-817)
Avail: NTIS HC/MF A99; 10 functional color pages CSCL 20D

N91-21079*# Advanced Projects Research, Inc., Moorpark, CA.
A MULTIDIMENSIONAL FINITE ELEMENT METHOD FOR CFD
Darrell W. Pepper and Joseph W. Humphrey *In* NASA, Lewis Research Center, Computational Fluid Dynamics Symposium on Aeropropulsion Jan. 1991 p 311-334 Original contains color illustrations (For primary document see N91-21062 13-02)
Avail: NTIS HC/MF A99; 10 functional color pages CSCL 20D

N91-21080*# Cornell Univ., Ithaca, NY.
THE PDF METHOD FOR TURBULENT COMBUSTION
S. B. Pope *In* NASA, Lewis Research Center, Computational Fluid Dynamics Symposium on Aeropropulsion Jan. 1991 p 335-346 (For primary document see N91-21062 13-02)
(Contract F33615-87-C-2821; NSF CBT-88-14655)
Avail: NTIS HC/MF A99; 10 functional color pages CSCL 20D

N91-21081*# Detroit Diesel Allison, Indianapolis, IN.
PRESSURE ALGORITHM FOR ELLIPTIC FLOW CALCULATIONS WITH THE PDF METHOD
M. S. Anand, S. B. Pope (Cornell Univ., Ithaca, NY.), and H. C. Mongia *In* NASA, Lewis Research Center, Computational Fluid Dynamics Symposium on Aeropropulsion Jan. 1991 p 347-362 (For primary document see N91-21062 13-02)
(Contract F33615-87-C-2821)
Avail: NTIS HC/MF A99; 10 functional color pages CSCL 20D

N91-21082*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
IMPLICIT SOLUTION OF THREE-DIMENSIONAL INTERNAL TURBULENT FLOWS
V. Michelassi, M.-S. Liou, Louis A. Povinelli, and F. Martelli (Florence Univ., Italy) *In its* Computational Fluid Dynamics Symposium on Aeropropulsion Jan. 1991 p 363-391 (For primary document see N91-21062 13-02)
(NASA Order C-99066-G)
Avail: NTIS HC/MF A99; 10 functional color pages CSCL 20D

N91-21083*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
NUMERICAL INVESTIGATION OF AN INTERNAL LAYER IN TURBULENT FLOW OVER A CURVED HILL
S.-W. Kim *In its* Computational Fluid Dynamics Symposium on Aeropropulsion Jan. 1991 p 393-407 (For primary document see N91-21062 13-02)
(NASA Order C-99066-G)
Avail: NTIS HC/MF A99; 10 functional color pages CSCL 20D

N91-21084*# Analytical Services and Materials, Inc., Hampton, VA.
COMPUTATION OF TURBULENT HIGH SPEED MIXING LAYERS USING A TWO-EQUATION TURBULENCE MODEL
J. R. Narayan and B. Sekar (Vigyan Research Associates, Inc., Hampton, VA.) *In* NASA, Lewis Research Center, Computational Fluid Dynamics Symposium on Aeropropulsion Jan. 1991 p 409-428 (For primary document see N91-21062 13-02)
(Contracts NAS1-18599; NAS1-18585)
Avail: NTIS HC/MF A99; 10 functional color pages CSCL 20D

N91-21085*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
HEAT TRANSFER, VELOCITY-TEMPERATURE CORRELATION, AND TURBULENT SHEAR STRESS FROM NAVIER-STOKES COMPUTATIONS OF SHOCK WAVE/TURBULENT BOUNDARY LAYER INTERACTION FLOWS
C. R. Wang, W. R. Hingst, and A. R. Porro *In its* Computational Fluid Dynamics Symposium on Aeropropulsion Jan. 1991 p 429-456 (For primary document see N91-21062 13-02)
Avail: NTIS HC/MF A99; 10 functional color pages CSCL 20D

N91-21086*# Pennsylvania State Univ., University Park.
WAVE MODELS FOR TURBULENT FREE SHEAR FLOWS
W. W. Liou and P. J. Morris *In* NASA, Lewis Research Center, Computational Fluid Dynamics Symposium on Aeropropulsion Jan.

1991 p 457-471 (For primary document see N91-21062 13-02)
Avail: NTIS HC/MF A99; 10 functional color pages CSCL 20D

N91-21087*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
COMPUTATION OF LAMINAR VISCOUS-INVISCID INTERACTIONS IN HIGH-SPEED INTERNAL FLOWS
David H. Rudy, James L. Thomas, and Ajay Kumar *In* NASA, Lewis Research Center, Computational Fluid Dynamics Symposium on Aeropropulsion Jan. 1991 p 473-486 (For primary document see N91-21062 13-02)
Avail: NTIS HC/MF A99; 10 functional color pages CSCL 20D

N91-21088*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
TWO AND THREE-DIMENSIONAL SHOCK-SHOCK INTERACTIONS ON THE BLUNT LEADING EDGES OF THE HYPERSONIC INLETS
D. J. Singh, Ajay Kumar, and S. N. Tiwari (Old Dominion Univ., Norfolk, VA.) *In* NASA, Lewis Research Center, Computational Fluid Dynamics Symposium on Aeropropulsion Jan. 1991 p 487-506 (For primary document see N91-21062 13-02)
Avail: NTIS HC/MF A99; 10 functional color pages CSCL 20D

N91-21089*# Analytical Services and Materials, Inc., Hampton, VA.
ZONAL ANALYSIS OF TWO HIGH-SPEED INLETS
A. D. Dilley, G. F. Switzer, and W. M. Eppard *In* NASA, Lewis Research Center, Computational Fluid Dynamics Symposium on Aeropropulsion Jan. 1991 p 507-519 (For primary document see N91-21062 13-02)
(Contract NAS1-18599)
Avail: NTIS HC/MF A99; 10 functional color pages CSCL 20D

N91-21090*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
DYNAMICS OF LOCAL GRID MANIPULATIONS FOR INTERNAL FLOW PROBLEMS
Peter R. Eiseman (Program Development Corp., White Plains, NY.), Aaron Snyder, and Yung K. Choo *In its* Computational Fluid Dynamics Symposium on Aeropropulsion Jan. 1991 p 521-546 (For primary document see N91-21062 13-02)
(Contract NAG3-877; F49620-89-C-0096)
Avail: NTIS HC/MF A99; 10 functional color pages CSCL 20D

N91-21091*# Illinois Univ., Urbana. Aeronautical and Astronautical Engineering.
GRID GENERATION STRATEGIES FOR TURBOMACHINERY CONFIGURATIONS
K. D. Lee and T. L. Henderson *In* NASA, Lewis Research Center, Computational Fluid Dynamics Symposium on Aeropropulsion Jan. 1991 p 547-558 (For primary document see N91-21062 13-02)
Avail: NTIS HC/MF A99; 10 functional color pages CSCL 20D

N91-21092*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
THE 3D COMPUTATION OF SINGLE-EXPANSION-RAMP AND SCRAMJET NOZZLES
H. T. Lai *In its* Computational Fluid Dynamics Symposium on Aeropropulsion Jan. 1991 p 559-582 (For primary document see N91-21062 13-02)
Avail: NTIS HC/MF A99; 10 functional color pages CSCL 20D

N91-21093*# Cincinnati Univ., OH. Dept. of Aerospace Engineering and Engineering Mechanics.
SOLUTION OF THREE-DIMENSIONAL AFTERBODY FLOW USING REDUCED NAVIER-STOKES EQUATIONS
H. M. H. Almahroos, P. K. Khosla, and S. G. Rubin *In* NASA, Lewis Research Center, Computational Fluid Dynamics Symposium on Aeropropulsion Jan. 1991 p 583-592 (For primary document see N91-21062 13-02)
(Grant AF-AFOSR-0096-90)
Avail: NTIS HC/MF A99; 10 functional color pages CSCL 20D

N91-21094*# Sverdrup Technology, Inc., Cleveland, OH.
RECENT UPDATE OF THE RPLUS2D/3D CODES
Y.-L. Peter Tsai *In* NASA, Lewis Research Center, Computational Fluid Dynamics Symposium on Aeropropulsion Jan. 1991 p 593-607 (For primary document see N91-21062 13-02)
(Contract NAS3-25266)
Avail: NTIS HC/MF A99; 10 functional color pages CSCL 20D

N91-21095*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
THE DIRECT SIMULATION OF HIGH-SPEED MIXING-LAYERS WITHOUT AND WITH CHEMICAL HEAT RELEASE
B. Sekar, H. S. Mukunda (Indian Inst. of Science, Bangalore.), and M. H. Carpenter *In* NASA, Lewis Research Center, Computational Fluid Dynamics Symposium on Aeropropulsion Jan. 1991 p 609-622 (For primary document see N91-21062 13-02)
(Contract NAS1-18585)
Avail: NTIS HC/MF A99; 10 functional color pages CSCL 20D

N91-21096*# La Sapienza Univ., Rome (Italy). Dipt. di Meccanica e Aeronautica.
COMPUTATIONAL MODELLING OF DUMP COMBUSTORS FLOWFIELD
D. Lentini and W. P. Jones (Imperial Coll. of Science and Technology, London, England) *In* NASA, Lewis Research Center, Computational Fluid Dynamics Symposium on Aeropropulsion Jan. 1991 p 623-634 (For primary document see N91-21062 13-02)
Avail: NTIS HC/MF A99; 10 functional color pages CSCL 20D

N91-21097*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
NUMERICAL SIMULATION OF TRANSVERSE FUEL INJECTION
Marlon Mao, David W. Riggins (Analytical Services and Materials, Inc., Hampton, VA.), and Charles R. McClinton *In* NASA, Lewis Research Center, Computational Fluid Dynamics Symposium on Aeropropulsion Jan. 1991 p 635-667 (For primary document see N91-21062 13-02)
Avail: NTIS HC/MF A99; 10 functional color pages CSCL 20D

N91-21098*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
A HIGHLY EFFICIENT ENGINEERING TOOL FOR THREE-DIMENSIONAL SCRAMJET FLOWFIELD AND HEAT TRANSFER COMPUTATIONS
Pradeep S. Kamath, Richard W. Hawkins, Nathaniel R. Baker (Lockheed Engineering and Sciences Co., Hampton, VA.), and Charles R. McClinton *In* NASA, Lewis Research Center, Computational Fluid Dynamics Symposium on Aeropropulsion Jan. 1991 p 669-681 (For primary document see N91-21062 13-02)
Avail: NTIS HC/MF A99; 10 functional color pages CSCL 20D

N91-21380# National Aerospace Lab., Tokyo (Japan).
COMPUTER REQUIREMENTS FOR FURTHER CFD DEVELOPMENT
Hajime Miyoshi *In its* Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics: Prospects of Computational Fluid Dynamics and Super Computers in Aerospace Science and Technology Sep. 1990 p 1-26 In JAPANESE; ENGLISH summary (For primary document see N91-21379 13-31)
Avail: NTIS HC/MF A06

N91-21381# Ishikawajima-Harima Heavy Industries Co. Ltd., Tokyo (Japan).
PRESENT AND FUTURE OF CFD ON THE AERO-ENGINE DEVELOPMENT IN IHI
Atsushige Tanaka *In* National Aerospace Lab., Proceedings of

the 8th NAL Symposium on Aircraft Computational Aerodynamics: Prospects of Computational Fluid Dynamics and Super Computers in Aerospace Science and Technology Sep. 1990 p 27-46 In JAPANESE; ENGLISH summary (For primary document see N91-21379 13-31)
Avail: NTIS HC/MF A06

N91-21382# Kawasaki Heavy Industries Ltd., Gifu (Japan). Aircraft Research Lab.
CFD RESEARCH AND SYSTEMS IN KAWASAKI HEAVY INDUSTRIES AND ITS FUTURE PROSPECTS
Koichi Hiraoka *In* National Aerospace Lab., Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics: Prospects of Computational Fluid Dynamics and Super Computers in Aerospace Science and Technology Sep. 1990 p 47-55 In JAPANESE; ENGLISH summary (For primary document see N91-21379 13-31)
Avail: NTIS HC/MF A06

N91-21383# Fuji Heavy Industries Ltd., Utsunomiya (Japan).
THE CFD ANALYSIS RELATED AEROSPACE IN FUJI HEAVY INDUSTRIES, LTD.
Kohei Tanaka, Hidehiro Hirose, and Yasuhiro Koshioka *In* National Aerospace Lab., Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics: Prospects of Computational Fluid Dynamics and Super Computers in Aerospace Science and Technology Sep. 1990 p 57-67 In JAPANESE; ENGLISH summary (For primary document see N91-21379 13-31)
Avail: NTIS HC/MF A06

N91-21384# Mitsubishi Heavy-Industries Ltd., Nagoya (Japan). Engineering Research Dept.
STATUS AND OUTLOOK OF CFD TECHNOLOGY AT MITSUBISHI HEAVY INDUSTRIES, NAGOYA
Tadayuki Tanioka *In* National Aerospace Lab., Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics: Prospects of Computational Fluid Dynamics and Super Computers in Aerospace Science and Technology Sep. 1990 p 69-81 In JAPANESE; ENGLISH summary (For primary document see N91-21379 13-31)
Avail: NTIS HC/MF A06

N91-21385# National Aerospace Lab., Tokyo (Japan).
CFD DEVELOPMENT PRESENT AND PROSPECTS AT NAL
Naoki Hirose and Koji Isogai *In its* Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics: Prospects of Computational Fluid Dynamics and Super Computers in Aerospace Science and Technology Sep. 1990 p 83-92 In JAPANESE; ENGLISH summary (For primary document see N91-21379 13-31)
Avail: NTIS HC/MF A06

N91-21387# Hitachi Ltd., Tokyo (Japan).
CFD SIMULATION ON A MASSIVELY PARALLEL PROCESSOR
Teruo Tanaka and Koichiro Omoda *In* National Aerospace Lab., Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics: Prospects of Computational Fluid Dynamics and Super Computers in Aerospace Science and Technology Sep. 1990 p 99-108 In JAPANESE; ENGLISH summary (For primary document see N91-21379 13-31)
Avail: NTIS HC/MF A06

35 INSTRUMENTATION AND PHOTOGRAPHY

Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography.

For aerial photography see *43 Earth Resources and Remote Sensing*. For related information see also *06 Aircraft Instrumentation*, and *19 Spacecraft Instrumentation*.

N91-21485*# Nebraska Univ., Lincoln.
COMPARISON OF UNL LASER IMAGING AND SIZING SYSTEM AND A PHASE DOPPLER SYSTEM FOR ANALYZING SPRAYS FROM A NASA NOZZLE Final Report
Dennis R. Alexander Mar. 1990 134 p
(Grant NAG3-634)
(NASA-CR-185239; NAS 1.26:185239) Avail: NTIS HC/MF A07 CSCL 14B

Research was conducted on characteristics of aerosol sprays using a P/DPA and a laser imaging/video processing system on a NASA MOD-1 air assist nozzle being evaluated for use in aircraft icing research. Benchmark tests were performed on monodispersed particles and on the NASA MOD-1 nozzle under identical lab operating conditions. The laser imaging/video processing system and the P/DPA showed agreement on a calibration tests in monodispersed aerosol sprays of + or - 2.6 micron with a standard deviation of + or - 2.6 micron. Benchmark tests were performed on the NASA MOD-1 nozzle on the centerline and radially at 0.5 inch increments to the outer edge of the spray plume at a distance 2 ft downstream from the exit nozzle. Comparative results at two operation conditions of the nozzle are presented for the two instruments. For the 1st case studied, the deviation in arithmetic mean diameters determined by the two instruments was in a range of 0.1 to 2.8 micron, and the deviation in Sauter mean diameters varied from 0 to 2.2 micron. Severe operating conditions in the 2nd case resulted in the arithmetic mean diameter deviating from 1.4 to 7.1 micron and the deviation in the Sauter mean diameters ranging from 0.4 to 6.7 micron. Author

N91-21486# Air Force Academy, CO. Dept. of Physics.
EXPERIMENTAL RESPONSE FUNCTIONS AND RESPONSE MATRICES FOR 2.54-cm X 2.54 cm AND 7.62 cm X 7.62 cm BISMUTH GERMANATE SCINTILLATION DETECTORS Final Report
Rex R. Kiziah and John R. Lowell Oct. 1990 70 p
(AD-A230140; USAFA-TR-90-11; AFWL-89-052) Avail: NTIS HC/MF A04 CSCL 17/8

We report experimental response functions at twelve gamma-ray energies over the range of 123.6 keV to 11.67 MeV for a 2.54-cm-diameter x 2.54-cm-long and a 7.62-cm-diameter x 7.62-cm long bismuth germanate scintillation detector. The measurements were made at, or corrected to correspond to, source-to-detector distances of 100 cm. The resolutions of the detectors at a gamma-ray energy of 661.6 keV are 11.6 percent for the small detector and 13.0 percent for the large detector. GRA

N91-21487# Southampton Univ. (England). Automotive Group.
ONE WAY TO REDUCE THERMAL EFFECTS IN A PIEZOELECTRIC PRESSURE TRANSDUCER MOUNTED IN THE COMBUSTION CHAMBER OF A C.I. ENGINE
Lin Sun (Chongqing Automobile Research Inst., China) and D. Anderton Sep. 1990 43 p
(ISVR-TR-189; ETN-91-98997) Avail: NTIS HC/MF A03

The development of a special heat shield is described. The shield is set in front of a pressure transducer in order to reduce thermal effects on the transducer and prevent it from being exposed to the high temperature flame in a diesel engine cylinder. Comparison tests with and without the shield carried out on a turbocharged diesel engine are described. The results show that the shield can give some thermal protection to the transducer, whilst allowing accurate frequency analysis of the pressure signal up to 5 kHz. Thus both performance and combustion noise measurements can be made simultaneously. ESA

N91-21488# Lawrence Livermore National Lab., CA.
X RAY LASER HOLOGRAPHY OF BIOLOGICAL MICROSTRUCTURES
J. Trebes, J. Brase, J. Gray, R. London, D. Matthews, D. Peters, D. Pinkel, G. Stone, M. Rosen, and T. Yorkey 14 Jan. 1991 10 p Presented at the 2nd International Colloquium on X Ray Lasers, York (UK), 17-21 Sep. 1990
(Contract W-7405-eng-48)
(DE91-008732; UCRL-JC-104229; CONF-9009266-11) Avail: NTIS HC/MF A02

The possibility of x ray laser holographic imaging of biological microstructures is reviewed. The coherent energy output and pulse length necessary for achieving good 3-D images of gold labeled human chromosomes is derived. DOE

N91-21489*# Georgia Inst. of Tech., Atlanta. School of Chemical Engineering.
FREQUENCY RESPONSE OF A SUPPORTED THERMOCOUPLE WIRE: EFFECTS OF AXIAL CONDUCTION Progress Report, Oct. 1990 - Mar. 1991
L. J. Forney, E. L. Meeks, and G. C. Fralick (National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.) Apr. 1991 57 p
(Contract NCC3-135)
(NASA-CR-188101; NAS 1.26:188101; E19-666-2) Avail: NTIS HC/MF A04 CSCL 14B

Theoretical expressions are derived for the steady state frequency response of a supported thermocouple wire. In particular, the effects of axial heat conduction are demonstrated for both a supported one material wire and a two material wire with unequal material properties across the junction. For the case of a one material supported wire, an exact solution is derived which compares favorably with an approximate expression that only matches temperatures at the supported junction. Moreover, for the case of a two material supported wire, an analytical expression is derived that closely correlates numerical results. Experimental data were taken with a type K supported thermocouple. The test thermocouple was constructed with dimensions to demonstrate the effects of axial heat conduction assuming constant physical properties across the junction. Author

N91-21490# European Space Agency, Paris (France).
ANGLE MEASUREMENTS WITH THE LASER GYRO GG 1342
Volker Wetzig, Egmar Luebeck, Wolfram Pahl, Dieter Ulrich, and Reiner Wittekopf (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick, Germany, F.R.) Nov. 1990 94 p Transl. into ENGLISH of Winkelmessungen mit dem Laaserkreisel GG 1342 (Brunswick, Fed. Republic of Germany, DLR), 1989 90 p Original language document was announced as N90-24579
(ESA-TT-1212; DLR-FB-89-50; ETN-91-98972) Avail: NTIS HC/MF A05

The characteristics of a ring laser gyro with regard to the accuracy are presented. The suitability of the laser gyro for static and dynamic angle measurements on a standard production Honeywell GG 1342 type with dither bias compensation was studied. The angle reference used for the static measurements was a 12-sided polygonal mirror in conjunction with a photoelectric autocollimation telescope. For the dynamic measurements, the inductosyn angle transducer of a gyro test table calibrated with the above-mentioned device was used. In the process it emerged that the laser gyro can also be used for fine calibration of a precise angle transducer. The influence of the gyro's scale factor and drift variations on the angle measurement deviations was investigated. Quantization noise was reduced in the data processing on the basis of fast sampling. Drift measurements included tests lasting one week. These results are also relevant for precise navigation and stabilization purposes. It transpired that random walk drift was the limiting factor for accuracy of nonrepeatable angle measurements. ESA

N91-21491# National Aerospace Lab., Tokyo (Japan).
SLANT HOT-WIRE INCLINATION MEASUREMENT USING DUAL LASER BEAMS
Shohei Takagi and Masayuki Honma Sep. 1990 9 p In JAPANESE; ENGLISH summary
(NAL-TR-1078; ISSN-0389-4010) Avail: NTIS HC/MF A02

A new method was developed for determining an exact slant hot-wire inclination to the axial flow direction in order to accurately measure the transverse velocity component. The method requires dual parallel laser beams near the focal point such as Laser-Two Focus velocimeter beams, one of which can rotate around the other. Since the squared hot-wire bridge output is proportional to the mean value of the beam intensity exposed on the hot-wire element, the bridge output indicates the maximum variation, when the slant wire is exposed to just dual beams. This beam rotating angle is referred to as the slant angle of the wire, if necessary, relative to the freestream angle, which is accurately given by the Laser-Two Focus velocimeter. Furthermore, it was found in the wire-inclination measurement that the beams rotate in precession due to optical misalignment. This precession is prone to serious errors in thin boundary-layer measurements. Author

N91-21492*# Illinois Inst. of Tech., Chicago. Dept. of Mechanical and Aerospace Engineering.
ELECTRO OPTICAL SYSTEM TO MEASURE STRAINS AT HIGH TEMPERATURE
Cesar A. Sciammarella 16 Jan. 1991 41 p
(Grant NAG2-547)
(NASA-CR-188148; NAS 1.26:188148) Avail: NTIS HC/MF A03 CSCL 14B

The goals of this proposal were to develop a prototype of an electro-optics system for the measurement of strains in structures at high temperatures and to perform a test under field conditions. In the research task section, the topics addressed include: (1) correction of the effect of vibrations and thermal currents by means of an active compensation system; (2) reduction of the speckle noise by means of electronic filter and TV signal reconstruction circuit; (4) compensation of the rigid body motions by mounting the camera in a universal motion system; and (5) removal of phase errors left by the active compensation system by dynamic reading. In the design and construction section, the topics addressed include: (1) preliminary design; (2) final design; (3) software development; (4) signal conditioning; (5) data processing; (6) recorrelation of two holograms in the presence of rigid body motions; and (7) phase extraction using a computer generated image. Testing in the high temperature oven is also addressed. K.S.

N91-21493* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
VOLUMETRIC MEASUREMENT OF TANK VOLUME Patent
Richard T. Walter, inventor (to NASA), Paul D. VanBuskirk, inventor (to NASA) (Lockheed Engineering and Sciences Co., Houston, TX.), William F. Weber, inventor (to NASA), and Richard C. Froebel, inventor (to NASA) 26 Mar. 1991 8 p Filed 28 Dec. 1989 Supersedes N91-13683 (29 - 5, p 663)
(NASA-Case-MSC-21500-1; US-Patent-5,001,924; US-Patent-Appl-SN-458258; US-Patent-Class-73-149; Int-Patent-Class-G01F-17/00) Avail: US Patent and Trademark Office CSCL 14B

A method is disclosed for determining the volume of compressible gas in a system including incompressible substances in a zero-gravity environment consisting of measuring the change in pressure (delta P) for a known volume change rate (delta V/delta t) in the polytrophic region between isothermal and adiabatic conditions. The measurements are utilized in an idealized formula for determining the change in isothermal pressure (delta P sub iso) for the gas. From the isothermal pressure change (delta iso) the gas volume is obtained. The method is also applicable to determination of gas volume by utilizing work (W) in the compression process. In a passive system, the relationship of specific densities can be obtained. NASA

N91-21494* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
FLEXIBLE DIAPHRAGM-EXTREME TEMPERATURE USAGE Patent
Guillermo Lerma, inventor (to NASA) (Rockwell International Corp., Canoga Park, CA.) 5 Feb. 1991 8 p Filed 23 Apr. 1987 Division of US-Patent-Appl-SN-771537, filed 30 Aug. 1985
(NASA-Case-MSC-20797-2; US-Patent-4,989,497;
US-Patent-Appl-SN-041389; US-Patent-Appl-SN-771537;
US-Patent-Class-92-103SD; US-Patent-Class-92-103F;
Int-Patent-Class-F01B-19/00) Avail: US Patent and Trademark Office CSCL 14B

A diaphragm suitable for extreme temperature usage, such as encountered in critical aerospace applications, is fabricated by a unique method, and of a unique combination of materials. The materials include multilayered lay-ups of diaphragm materials sandwiched between layers of bleeder fabrics. After being formed in the desired shape on a mold, they are vacuum sealed and then cured under pressure, in a heated autoclave. A bond capable of withstanding extreme temperatures are produced.
Official Gazette of the U.S. Patent and Trademark Office

N91-21495* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
TANK GAUGING APPARATUS AND METHOD Patent
Brian G. Morris, inventor (to NASA) 15 Jan. 1991 8 p Filed 28 Feb. 1990 Division of US-Patent-Appl-SN-396726, filed 18 Aug. 1989
(NASA-Case-MSC-21059-3; US-Patent-4,984,457;
US-Patent-Appl-SN-486455; US-Patent-Appl-SN-396726;
US-Patent-Class-73-149; Int-Patent-Class-G01F-17/00) Avail: US Patent and Trademark Office CSCL 14B

Apparatus for gauging the amount of liquid in a container of liquid and gas under flow or zero gravity net conditions includes an accumulator and appropriate connector apparatus for communicating gas between the accumulator and the container. In one form of the invention, gas is removed from the container and compressed into the accumulator. The pressure and temperature of the fluid in the container is measured before and after removal of the gas; the pressure and temperature of gas in the accumulator is measured before and after compression of the gas into the accumulator from the container. These pressure and temperature measurements are used in determining the volume of gas in the container, whereby the volume of liquid in the container can be determined from the difference between the known volume of the container and the volume of gas in the container. Gas from the accumulator may be communicated into the container in a similar process as a verification of the gauging of the liquid volume, or as an independent process for determining the volume of liquid in the container.
Official Gazette of the U.S. Patent and Trademark Office

N91-21496* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
WET ATMOSPHERIC GENERATION APPARATUS Patent
Richard M. Hamner, inventor (to NASA) (Teledyne Brown Engineering, Huntsville, AL.) and Janice K. Allen, inventor (to NASA) 20 Mar. 1990 7 p Filed 12 Dec. 1988
(NASA-Case-MFS-28177-1; US-Patent-4,909,436;
US-Patent-Appl-SN-283092; US-Patent-Class-236-44A;
US-Patent-Class-165-20; US-Patent-Class-236-94;
US-Patent-Class-417-190; Int-Patent-Class-B01F-3/02) Avail: US Patent and Trademark Office CSCL 14B

The invention described relates to an apparatus for providing a selectively humidified gas to a camera canister containing cameras and film used in space. A source of pressurized gas (leak test gas or motive gas) is selected by a valve, regulated to a desired pressure by a regulator, and routed through an ejector (venturi device). A regulated source of water vapor in the form of steam from a heated reservoir is coupled to a low pressure region of the ejector which mixes with high velocity gas flow through the ejector. This mixture is sampled by a dew point sensor to obtain dew point thereof (ratio of water vapor to gas) and the apparatus adjusted by varying gas pressure or water vapor to provide a mixture at a connector having selected humidity content.
Official Gazette of the U.S. Patent and Trademark Office

N91-21497# Lawrence Livermore National Lab., CA.
STRESS-STRAIN GAGE MEASUREMENTS ON A NEVADA TEST SITE (NTS) EVENT USING PAIRS OF TRIPLE FOIL GAGES
E. J. Kansa and R. B. Stout 30 Nov. 1990 32 p Presented at the 37th Instrument Society of America International Instrumentation Symposium, San Diego, 5-9 May 1991
(Contract W-7405-eng-48)
(DE91-005061; UCRL-JC-105356; CONF-910598-1) Avail: NTIS HC/MF A03

A triple-material stress-strain gage containing foils of ytterbium, manganin, and constantan was tested at the Lawrence Livermore National Labortory. This gage yields three independent piezoresistance measurements from which an independent set of principal strains and principal stresses can be inferred. We have analyzed the signals from a gage at a specific location buried at a distance from the center of energy of an event at the Nevada Test Site. We inverted the resistivity signals to calculate the stress and strain histories as sensed by the foils. Using the elastic material properties and the traction and displacement conditions at the various material interfaces from the foils to the host geological medium, we calculated the stress and strain histories in the host geological medium. However, because of uncertainties in the elastic properties of the layers of surrounding materials, we calculated significant variations in both the peaks and signatures of the stress and strain histories that could produce the foil stress and strain histories. We conclude that, because of the inclusion problem, accurate measurements of the stress-strain histories in the host geological medium can be adequately addressed only by minimizing, as much as possible, such uncertainties. DOE

N91-21498# Lawrence Livermore National Lab., CA.
PRELIMINARY FIELD DEMONSTRATION OF A FIBER-OPTIC TCE SENSOR
S. M. Angel, K. Langry, J. Roe, B. W. Colston, Jr., P. F. Daley, and F. P. Milanovich Feb. 1991 9 p Presented at the 4th OE/LASE 91 Society of Photo-Optical Instrumentation Engineers (SPIE) International Symposium, Los Angeles, 20-25 Jan. 1991
(Contract W-7405-eng-48)
(DE91-008453; UCRL-JC-105391; CONF-910123-13) Avail: NTIS HC/MF A02

We have developed a differential-absorption fiber-optic sensor for use in groundwater and vadose zone monitoring of certain volatile organochlorines. The principle of detection is a quantitative, irreversible chemical reaction that forms visible light-absorbing products. The sensor has been evaluated against gas chromatographic (GC) standard measurements and has demonstrated accuracy and sensitivity sufficient for the environmental monitoring of trace levels of trichloroethylene (TCE) and chloroform. This sensor is currently under evaluation in monitoring well and vadose zone applications. In this paper, we describe the principles of the existing single measurement sensor technology and show preliminary field-test results. DOE

N91-21499# Duke Univ., Durham, NC. Dept. of Computer Science.
VERY HIGH SPEED HOLOGRAPHIC MESSAGE ROUTING FOR PARALLEL MACHINES Final Report, 1 Sep. 1988 - 31 Aug. 1990
John H. Reif 1 Sep. 1990 11 p
(Contract DAAL03-88-K-0195)
(AD-A230965; ARO-26277.7-PH) Avail: NTIS HC/MF A03
CSCL 12/7

An important problem in massively parallel processing machines is the communication bottleneck. For example, in the Connection Machine, a 65,536 SIMD parallel processing message routing is one thousand times slower than the instruction time of an individual processor. This is, in part, due to contention problems and in part to the necessity for global control of the interconnection network.

Our approach to solve this problem is to implement a fully-parallel, high-speed message router, using locally-controlled spatial light modulators and volume holograms. Johnson and Reif devised an efficient electro-optical message routing system. We implemented a small prototype holographic router for demonstration of basic principals. The routing system uses a volume hologram to do message switching. It uses optimal O(n log(n)) number of switches, constant time, and optimal volume. This work can be applied to do very high speed message routing for massively parallel machines such as required by the Connection Machine. GRA

N91-21500# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
A CRITERION FOR THE OPTIMAL DESIGN OF MULTI-AXIS FORCE SENSORS Memorandum Report
Antonio Bicchi Oct. 1990 32 p
(Contract N00014-86-K-0685)
(AD-A231014; AI-M-1263) Avail: NTIS HC/MF A03 CSCL 12/9

This paper deals with the design of multi-axis force (also known as force/torque) sensors, as considered within the framework of optimal design theory. Optimal design procedures consist of finding the combination of design variables that extremizes some optimality criterion: provided a suitable mathematical formulation of the problem, solutions can be efficiently obtained through currently available numerical techniques. The principal goal of this paper is to identify a mathematical objective function, whose minimization corresponds to the optimization of sensor accuracy. The methodology employed is derived from linear algebra and analysis of numerical stability. An objective function which can be applied to a large class of sensor configurations is proposed. The problem of optimizing the number of basic transducers employed in a multi-component sensor is also addressed. Finally, applications of the proposed method to the design of a simple sensor as well as to optimization of a novel, 6-axis miniaturized sensor are discussed. GRA

N91-21501# Calspan Corp., San Diego, CA.
CONSTANT-CURRENT STAGNATION-POINT FILM-ANEMOMETER PROBE Final Report, Jun. - Dec. 1989
Anthony Demetriades Jan. 1991 50 p
(Contract F40600-85-C-0020)
(AD-A231048; AEDC-TR-90-35) Avail: NTIS HC/MF A03 CSCL 20/4

Hypersonic turbulence measurements of boundary layer stability and pressure, temperature, and velocity fluctuation levels in continuous-flow wind tunnels can require survey probes capable of withstanding uncommonly hostile test conditions, especially of temperature and dynamic pressure. Stagnation-point hot-film anemometer probes have demonstrated good durability in AEDC tunnels at Mach numbers 4, 6, and 8. The present report addresses questions associated with the use of such probes for the quantitative measurement of flow fluctuations in wind tunnel test applications. The steady-state and time-dependent response characteristics of the hot-film probe are analyzed. The film is assumed infinitesimally thin, subjected to a constant electric current during operation, and deposited on a substrate in which the heat flow is one-dimensional. The conduction equation in the substrate is solved simultaneously with the film power flow, conductive transfer to the substrate, and ohmic heating. It is found that the film response is describable by two parameters: (1) the intrinsic (no-substrate) film time constant, and (2) a substrate loss factor which is a mix of the film, flow, and substrate properties. The flow-fluctuation sensitivities of the heated film sensor are found to be similar to those of hot wires. GRA

N91-21502# Environmental Research Inst. of Michigan, Ann Arbor.
HOLOGRAPHIC LENS FOR WIDE FIELD-OF-VIEW LASER COMMUNICATION RECEIVER Final Technical Report, 1 May - 31 Dec. 1989
A. Tai, M. Eismann, and B. Neagle Mar. 1990 62 p
(Contract DLA900-88-D-0392)
(AD-A231620; ERIM-213325-3-F) Avail: NTIS HC/MF A04 CSCL 25/3

The design and fabrication of a wide field-of-view (FOV) holographic lens for use in a laser receiver are described. The holographic lens is designed to image incoming laser radiation at 850 nm onto a solid state detector array over a field-of-view of +/- 22.5 degrees x + or - 16 degrees (+/- 26.7 degrees in the diagonal direction). Experimental results obtained with the holographic wide FOV laser receiver are presented. The location of the focussed spot can be determined to within one pixel of the detector array, providing the laser receiver with an angular resolution better than 1 mrad. GRA

36 LASERS AND MASERS

Includes parametric amplifiers.
For related information see also *76 Solid-State Physics.*

N91-21503# Lawrence Livermore National Lab., CA.
MODELING THE ABSORPTION OF INTENSE, SHORT LASER PULSES IN STEEP DENSITY GRADIENTS
W. E. Alley 28 Jan. 1991 7 p Presented at the OE/LASE '91: 4th Society of Photo-Optical Instrumentation Engineers (SPIE) International Symposium, Los Angeles, CA, 20-25 Jan. 1991
(Contract W-7405-eng-48)
(DE91-008735; UCRL-JC-106275; CONF-910123-14) Avail: NTIS HC/MF A02

A subroutine which calculates the absorption of short pulse electromagnetic radiation in a material has been installed into the laser fusion modeling program called LASNEX. Calculational results show the necessity for NLTE physics to account for ionization, the development of non-exponential density profiles for the expanding plasma and movement of the critical point toward the surface which results in Doppler shifts of the reflected light. Comparison of calculations of local scale lengths with experiments shows not only good agreement but the correct scaling with intensity. DOE

N91-21504# Lawrence Livermore National Lab., CA.
TOWARD HIGH BRIGHTNESS, MULTI-KILOWATT SOLID STATE LASERS
L. E. Zapata and K. R. Manes Nov. 1990 25 p Presented at the 9th International Congress on The Applications of Lasers and Electro-optics: ICALEO '90, Boston, 4-9 Nov. 1990
(Contract W-7405-eng-48)
(DE91-008990; UCRL-JC-104394; CONF-9011155-2) Avail: NTIS HC/MF A03

High average power (HAP) solid state laser output with improved beam quality has introduced new capabilities in materials processing. At the 500 W level and with a beam quality of a 'few' times the diffraction limit, the General Electric Nd:YAG slab is able to drill 5 cm of stainless steel in a few seconds. We expect that 2 to 3 kW of near infrared laser output in a low order spatial mode would enable metal working now unknown to industry. The HAP output of slab lasers is limited by the size of the available laser crystals and the pump power. Core free, 6-cm diameter Nd:YAG boules have been grown on an experimental basis. High optical quality Nd:GGG can be obtained up to 10 cm in diameter. We present the results of our modeling based on these crystals pumped by advanced arc-lamps or laser diode arrays. We project HAP laser outputs of 1.6 kW from an existing Vortek (trademark) pumped NG:GGG oscillator and about 2 kW from diode pumped Nd:YAG device. Several kW of laser output can be expected from two such slabs in a MOPA configuration before optical damage limits are reached. The three-dimensional stress-optic code which we used to optimize our designs, was normalized to available experimental data obtained with the above Nd:GGG slab at the 500 W level and a 40 W diode pumped Nd:YAG test bed. Our calculations indicate the essential parameters for attainment of high beam quality. Cooling uniformity across the pumped faces of the slab is critical and the location of the transition between pumped

and un-pumped regions towards the slab tips is very important. A flat pumping profile was found to be desirable and predicted one wave of distortion which should be correctable over about 75 percent of the aperture however, an even better wavefront was predicted over 90 percent of the aperture when the regions near the edges of the slab were slightly over-pumped relative to the central regions and the regions near to the ends were tapered to compensate for transition effects. DOE

N91-21505# Sandia National Labs., Albuquerque, NM.
SURFACE CLEANING BY LASER ABLATION
H. C. Peebles, N. A. Creager, and D. E. Peebles 1991 14 p Presented at the Environmentally Conscious Manufacturing/Technology Applications Workshop, Albuquerque, 20 Feb. 1991
(Contract DE-AC04-76DP-00789)
(DE91-009189; SAND-91-0505C; CONF-910279-12) Avail: NTIS HC/MF A03

Nd:YAG laser cleaning of metal oxides from 304L stainless steel surfaces was characterized. Thin chromium oxide films can be completely removed from the surface using a single 10 nsec pulse of laser radiation with an average surface irradiance greater than 120 MW/sq cm. Laser etching of thicker iron oxide films exhibit a self-limiting effect that prevents overetching into the stainless steel substrate. DOE

N91-21506# Sandia National Labs., Albuquerque, NM.
A DISCUSSION OF THE XENON LASER INTENSITY AS A FUNCTION OF PUMP RATE
P. J. Brannon Feb. 1991 9 p
(Contract DE-AC04-76DP-00789)
(DE91-009225; SAND-90-3122) Avail: NTIS HC/MF A02

The output intensity of a laser can be expressed in the form I(sub out) = Ag(sub 0)I(sub s) + BI(sub s). The constants A and B are independent of the pump rate for laser systems with nonsaturable losses, but both g(sub 0)I(sub s) and I(sub s) can depend upon the pump rate. Methods for determining the pump rate dependence of g(sub 0)I(sub s) and I(sub s) are given for experiments in which the pump rate varies continuously. DOE

N91-21507# Sandia National Labs., Albuquerque, NM.
OPTICAL PROPERTIES OF A NUCLEAR REACTOR PUMPED GAS LASER
A. Corvo Jan. 1991 42 p
(Contract DE-AC04-76DP-00789)
(DE91-009226; SAND-90-2552) Avail: NTIS HC/MF A03

Ray paths and focal lengths are derived to fourth order for a nuclear-reactor wall-pumped gas laser. Ray paths in the laser gain cell are shown to be nearly random for a long gain region. Focal lengths calculated from the ray paths exiting the laser are shown to oscillate between + or - infinity during pumping. The use of stimulated Brillouin scattering as a means for beam clean-up is discussed with the conclusion that the phase conjugated beam would cycle on and off as the ray paths and focal lengths oscillate between extremes. The parameters determining this cycling effect and its characteristics are also derived. DOE

N91-21508# California Univ., Berkeley. Lawrence Berkeley Lab.
DESIGN OVERVIEW OF A HIGHLY STABLE INFRARED FREE ELECTRON LASER AT LBL
K. J. Kim, M. Berz, S. Chattopadhyay, R. Gough, C. Kim, A. H. Kung, M. Xie, J. Edighoffer, and W. Stein Nov. 1990 13 p Presented at the 12th International Free Electron Laser Conference, (FEL-12), Paris, France, 17-21 Sep. 1990
(Contract DE-AC03-76SF-00098)
(DE91-009327; LBL-29957; CONF-9009166-20; ESG-112) Avail: NTIS HC/MF A03

An infrared free electron laser (IRFEL) is being designed for the Chemical Dynamics Research Laboratory (CDRL) at LBL. The FEL is based on a 50 MeV RF linac operating in synchronization to the Advanced Light Source (ALS), and will produce intense (100 (mu)J per micropulse), narrow bandwidth (narrower than 0.1 percent) radiation between 3 (mu) and 50 (mu). In the design, we pay particular attention to the FEL stability issues and require that the fluctuations in electron beam energy and in timing be less then 0.05 percent and 0.1 ps respectively. The FEL spectrum can then be stabilized to about 10(exp -3), or if grating is used, to 10(exp -4). We discuss various sources of fluctuations in the gun, the bunchers and the accelerator sections, as well as the feedback and feedforward schemes to reduce these fluctuations. The accelerator structure is chosen to be of the side coupled, standing wave type for easier control. The beam transport is made isochronous to avoid the coupling between the energy and the timing fluctuations. DOE

N91-21509# Lawrence Livermore National Lab., CA.
THE THEORY OF TEMPORAL COMPRESSION OF INTENSE PULSES IN A METAL VAPOR
M. J. Shaw and J. K. Crane 16 Nov. 1990 7 p Presented at the CLEO '91: Conference on Lasers and Electro-Optics, Baltimore, 12-17 May 1991
(Contract W-7405-eng-48)
(DE91-005059; UCRL-JC-105424; CONF-910595-2) Avail: NTIS HC/MF A02

We examine compression of near-resonant pulses in metal vapor in the nonlinear regime. Our calculations examine nonlinear effects on compression of optimally-chirped pulses of various fluences. In addition, we compare model predictions with experimental results for compression of 4 nsec Nd:YAG pumped dye pulses. DOE

N91-21510# Sandia National Labs., Albuquerque, NM.
HIGH EFFICIENCY SURFACE-EMITTING SEMICONDUCTOR LASER RESONATORS
P. L. Gourley, M. E. Warren, G. A. Vawter, G. R. Hadley, T. M. Brennan, B. E. Hammons, L. R. Dawson, C. F. Schaus, and S. Sun (New Mexico Univ., Albuquerque.) 1990 8 p Presented at the CLEO '91: Conference on Lasers and Electro-Optics, Baltimore, 12-17 May 1991
(Contract DE-AC04-76DP-00789)
(DE91-005236; SAND-90-2998C; CONF-910595-1) Avail: NTIS HC/MF A02

We have synthesized a new tool, a lasing phase diagram, for designing high efficiency surface-emitting laser resonators and have demonstrated its usefulness by fabricating and operating many different laser resonators. DOE

N91-21511# Lawrence Livermore National Lab., CA.
LASER PULSE COMPRESSION IN STRONTIUM AND CALCIUM VAPOR
J. K. Crane, J. D. Cooke, M. J. Shaw, R. W. Presta, J. J. Christensen, M. A. Johnson, H. W. Friedman, and J. A. Paisner 16 Nov. 1990 8 p Presented at the CLEO '91: Conference on Lasers and Electro-Optics, Baltimore, 12-17 May 1991
(Contract W-7405-eng-48)
(DE91-007346; UCRL-JC-105541; CONF-910595-3) Avail: NTIS HC/MF A02

Application of vapor pulse compression for increasing the intensity of a large copper vapor laser pumped dye laser for x ray generation is limited by collisional absorption and nonlinear pulse breakup. Measurements of these effects are discussed. DOE

N91-21512# Sandia National Labs., Albuquerque, NM.
THEORY OF SEMICONDUCTOR LASER FEEDBACK INSTABILITY
M. Lindberg, M. Rose, M. Sargent, III, S. W. Koch (Arizona Univ., Tucson.), and W. Chow 1991 8 p Presented at the CLEO '91: Conference on Lasers and Electro-Optics, Baltimore, 12-17 May 1991
(Contract DE-AC04-76DP-00789)
(DE91-008198; SAND-91-0412C; CONF-910595-4) Avail: NTIS HC/MF A02

A semiconductor laser coupled to an external cavity is investigated using a composite-cavity mode approach. Strong

frequency hopping for small cavity length changes is obtained, indicating instability of the laser operation against cavity lengths fluctuations. DOE

N91-21513# Brookhaven National Lab., Upton, NY.
AMPLIFICATION OF FEMTOSECOND PULSES USING A N2 PUMP LASER
T. Srinivasan-Rao, T. Tsang, and J. Fischer Nov. 1990 8 p Presented at the CLEO '91: Conference on Lasers and Electro-Optics, Baltimore, 12-17 May 1991
(Contract DE-AC02-76CH-00016)
(DE91-008413; BNL-45415; CONF-910595-5) Avail: NTIS HC/MF A02

The CPM output was amplified by pumping an axicon Bethune dye cell with N2 laser obtaining 1 microJ in 150 fs with signal to noise ratio of greater than 200 and Gaussian spatial profile. System performance for various input pulse durations and methods to increase the amplified energy will be discussed. DOE

N91-21514# Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics.
HIGH BRIGHTNESS ELECTRON BEAM PRODUCTION BY LASER INDUCED VARIOUS ORDER MULTIPHOTON PHOTOEFFECTS OF GOLD
Cs. Toth, Gy. Farkas, D. Charalambidis, E. Hontzopoulos, and C. Fotakis (Crete Univ., Iraklion, Greece) 1990 7 p Presented at the Workshop on Short Pulse High Current Cathodes, Bendor (France), 18-22 Jun. 1990
(DE91-009150; CONF-9006242-5-Vugraphs) Avail: NTIS HC/MF A02

The laser induced electron emission from metals and comparative measurements on various order multiphoton photoeffects is discussed. DOE

N91-21515# Brookhaven National Lab., Upton, NY.
HIGH CURRENT PHOTOEMISSION WITH 10 PICOSECOND UV PULSES
J. Fischer, T. Srinivasan-Rao, and T. Tsang Jun. 1990 32 p Presented at the Workshop on Short Pulse High Current Cathodes, Bendor (France), 18-22 Jun. 1990
(Contract DE-AC02-76CH-00016)
(DE91-009439; BNL-45443; CONF-9006242-6) Avail: NTIS HC/MF A03

The quantum efficiency and the optical damage threshold of various metals were explored with 10 ps, 266 nm, UV laser pulses. Efficiencies for Cu, Y, and Sm were: 1.4, 5, and 7 x 10(exp -4), with damage thresholds about 100, 10, and 30 mJ/sq cm. This would permit over 1 microC/sq cm or current densities exceeding 100 kA/sq cm. High charge and current densities of up to 66 kA/sq cm were obtained on 0.25 mm diam cathodes, and 21 kA/sq cm on a 3 mm diam yttrium cathode. The maximum currents were limited by space charge and the dc field. The experiments with small area illumination indicate that the emitted electrons spread transversely due to Coulomb repulsion and their initial transverse velocity. This increases the effective area above the cathode, reduces the space charge effect and increases emission density on the cathode. The quantum efficiency can be increased substantially by enhancing the field on the surface by either a suitable electrode geometry or microstructures on it. DOE

N91-21516# Lawrence Livermore National Lab., CA.
THE BASIS VERSION OF LASNEX
P. F. Dubois 26 Oct. 1990 9 p Presented at the 1990 Nuclear Explosives Code Developers' Conference, Monterey, 6-9 Nov. 1990
(Contract W-7405-eng-48)
(DE91-009483; UCRL-JC-105123; CONF-9011149-14) Avail: NTIS HC/MF A02

We have made major changes to the computer science aspects of our laser fusion simulation program LASNEX. LASNEX is now using the Basis system, a FORTRAN development system developed over the last six years at Lawrence Livermore National Laboratory. This has given users greatly increased power and flexibility. We have eliminated all non-standard usage and macros, enabling us to begin the port of LASNEX to workstations. At the same time, we have completely redone the system used to maintain the source and create new versions of LASNEX, resulting in major gains in capability and productivity. DOE

N91-21517# Georgia Inst. of Tech., Atlanta. School of Physics.
STATISTICAL FLUCTUATIONS IN LASERS
R. Roy 1990 3 p
(Contract DE-FG05-87ER-13708)
(DE91-009540; DOE/ER-13708/T2) Avail: NTIS HC/MF A01

This report discusses the detection of weak optical signals by super-regenerative laser receivers; studies of interaction of fluctuating fields with atoms; and investigation of four-wave mixing in optical fibers. DOE

N91-21518# Lawrence Livermore National Lab., CA.
LASER TEST FOR SPINDLE PARALLELISM
S. L. Thompson and Carl A. Chung 15 May 1990 4 p
(Contract W-7405-eng-48)
(DE91-009716; UCRL-ID-104094) Avail: NTIS HC/MF A01

The purpose of this test was to check the sign convention of the straightness interferometer, when it was being used to assess a spindle for parallelism to a linear axis. The sign becomes all important when removing the alignment error of the straightness reflector, from the machine error. The following diagram illustrates what happens with a conventional straightedge, and indicator, assuming a perfect axis alignment (except for a bump near the headstock), and a deliberately misaligned straight edge. DOE

N91-21519# Naval Research Lab., Washington, DC.
FREE ELECTRON LASERS Memorandum Report
Cha-Mei Tang 9 Jan. 1991 9 p
(Contract N00014-87-F-0066)
(AD-A230817; NRL-MR-6753) Avail: NTIS HC/MF A02 CSCL 09/3

Free electron lasers (FELs) comprised a class of potentially efficient devices capable of generating high quality coherent radiation, continuously tunable from the microwave region of the x ray region, at high average and/or high peak power. A short description of the physics of the FEL and its applications are described in this paper. The FEL is now becoming a research tool rather than a pure research topic. The light properties at the currently funded FEL user facilities are listed. GRA

N91-21520# Texas Univ. at Dallas, Richardson. Center for Quantum Electronics.
PROOF OF THE FEASIBILITY OF COHERENT AND INCOHERENT SCHEMES FOR PUMPING A GAMMA RAY LASER Annual Letter Report, 24 Dec. 1989 - 23 Dec. 1990
C. B. Collins 31 Dec. 1990 54 p
(Contract N00014-90-K-2001)
(AD-A230897; UTD-GRL/9001) Avail: NTIS HC/MF A04 CSCL 09/3

The most productive approaches to the problem of the gamma-ray laser have focused upon upconversion techniques in which metastable nuclei are pumped with long wavelength radiation. At the nuclear level the storage of energy can approach tera-Houles per liter for thousands of years. The nuclear analog to the ruby laser is examined. The simplest concepts for a gamma-ray laser and not surprisingly, the greatest rate of achievement in the quest for a subAngstrom laser was realized in that direction. For ruby the identification and exploitation of a bandwidth funnel were the critical keys in the development of the first laser. There was a broad absorption band linked through efficient cascading to the narrow laser level. The current report focused upon two issues. The first concerned the extent to which the breakthrough discovery of the giant pumping resonances would alter the prescription for a gamma-ray laser formulated nearly a decade ago. Detailed in the first preprint is the recomputation of the model for a realistic device. The second emphasis fell upon experiments conducted to pinpoint the excitation energies of the resonances for 180Ta and 123Te. GRA

N91-21521# International Business Machines Corp., San Jose, CA.
FINDING A SINGLE MOLECULE IN A HAYSTACK: LASER SPECTROSCOPY OF SOLIDS FROM SQUARE ROOT OF (N TO N) =1
W. E. Moerner and W. P. Ambrose 2 Jan. 1991 11 p
(Contract N00014-84-C-0708)
(AD-A230910; TR-30) Avail: NTIS HC/MF A03 CSCL 20/5

Recent progress in the optical detection and spectroscopy of single ions in vacuum confined in electromagnetic traps has led to novel measurements that further the understanding of quantum physics. For example, various workers have achieved direct measurement of quantum jumps, Doppler sidebands, and other fundamental phenomena such as ion crystallization of ions in vacuum trapped by electromagnetic fields. By using laser induced fluorescence and a novel hydrodynamically focused flow to confine the molecules and reduce the scattering volume, single molecules of the protein B-phycoerythrin with the equivalent of 25 rhodamine 6G chromophores were also detected. In contrast to the far field optical approach, recent advances with various near field spectroscopies such as scanning tunnelling microscopy (STM) have provided images of single molecules of benzene and CO on Rh surfaces and images of liquid crystal molecules on graphite to name a few examples. GRA

N91-21522# Rochester Univ., NY. Inst. of Optics.
STOCHASTIC AND DETERMINISTIC FLUCTUATIONS IN STIMULATED BRILLOUIN SCATTERING Ph.D. Thesis
Alexander L. Gaeta Oct. 1990 139 p
(Contract DAAL03-86-K-0173)
(AD-A230988; ARO-24626.176-PH-UIR) Avail: NTIS HC/MF A07 CSCL 20/5

The dynamical behavior of stimulated Brillouin scattering (SBS) under a variety of conditions is investigated both theoretically and experimentally. Under conditions of a single continuous-wave laser field, the initiation of the SBS process is treated by including the thermal fluctuations of the material density which lead to spontaneous Brillouin scattering. Predictions are made for the threshold of the Stokes light. The spectrum of the output Stokes light is predicted to exhibit gain-narrowing as the input laser intensity is increased. Under certain conditions, the Stokes output intensity is expected to exhibit nearly 100 percent fluctuations even far above the threshold for SBS. Experiments performed in a single-mode optical fiber verify many of the predictions of the theory. Stimulated Brillouin scattering in the presence of two counterpropagating laser beams is studied. Under these conditions, the laser beams become temporally unstable to the growth of Stokes and anti-Stokes light. For the case when the input intensities of the two waves are comparable, the threshold for instability can be significantly lower than he threshold for usual single-beam SBS and, for the case of a broad Brillouin line, the system can show a period-doubling route to chaos. This Brillouin instability was observed experimentally using carbon disulfide as the Brillouin-active material. GRA

N91-21523# Stanford Univ., CA. Dept. of Statistics.
RESEARCH STUDIES ON EXTREME ULTRAVIOLET AND SOFT X RAY LASERS Annual Technical Report, 1 Sep. 1989 - 31 Aug. 1990
S. E. Harris Oct. 1990 13 p
(Contracts F49620-88-C-0120; ARO-MIPR-105-90)
(AD-A231033) Avail: NTIS HC/MF A03 CSCL 09/3

The purpose of this program is to study the physics, technology, and spectroscopy of extreme ultraviolet (XUV), and soft x ray lasers. The objective of the work is to develop a class of fixed frequency and tunable lasers whose wavelengths span the 100 A to 1000 A spectral region. Interested also exists in developing concepts and ideas that are applicable to other regions of the spectrum. Work is in several areas. These are: (1) The development of extreme ultraviolet sources of radiation based on pumping with synchronous traveling wave x rays. (2) The theoretical study and the beginning of experimental studies on lasers without inversion and on laser induced transparency. Studies were begun on new types of nonlinear optical processes using electromagnetically induced transparency. GRA

N91-21524# Air Force Inst. of Tech., Wright-Patterson AFB, OH.
KALMAN FILTER TRACKING OF A REFLECTIVE TARGET USING FORWARD LOOKING INFRARED MEASUREMENTS AND LASER ILLUMINATION M.S. Thesis
Roger J. Evans Dec. 1990 318 p
(AD-A231196; AFIT/GE/ENG/90D-20) Avail: NTIS HC/MF A14 CSCL 17/5

This thesis investigates Kalman filter tracking of a missile hardbody, at a range of 2,000 kilometers, using forward looking infrared (FLIR) measurements and low-energy laser illumination of the missile hardbody. A missile reflectivity model provides realism in the simulation. The tracking scenario uses one filter, provided with FLIR measurements, to estimate the intensity centroid location of the missile's plume. A second, independent, filter estimates the center-of-mass of the missile hardbody. The center-of-mass measurements provided to this filter are computed from information gathered by scanning a low-energy laser along the first filter's estimate of the missile velocity vector. Single scans of the laser produce 20 percent reflection returns, while a sweep (multiple scans) provides a measurement at each sample time. The need for a laser sweep results from inaccurate filter pointing of the FLIR sensor. A comparison between a one-state and two-state filter in estimating the hardbody center-of-mass shows that a one-state estimator performs as well as a two-state filter, with almost no error. The principle error in estimating the missile center-of-mass is along the centerline of the missile, for which the one-state filter is tuned. Author (GRA)

N91-22023# Harvard-Smithsonian Center for Astrophysics, Cambridge, MA.
SUBMILLIMETER WATER MASERS AT 321 AND 325 GHz
Karl M. Menten, Gary J. Melnick, and Thomas G. Phillips (California Inst. of Tech., Pasadena.) *In* ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 243-247 (For primary document see N91-21986 13-89)
Copyright Avail: NTIS HC/MF A17; EPD, ESTEC, Noordwijk, Netherlands, HC 80 Dutch guilders

N91-22024# California Univ., Berkeley.
EXCITATION OF SUBMILLIMETER WATER MASERS Abstract Only
David A. Neufeld and Gary J. Melnick (Harvard-Smithsonian Center for Astrophysics, Cambridge, MA.) *In* ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 249 (For primary document see N91-21986 13-89)
Copyright Avail: NTIS HC/MF A17; EPD, ESTEC, Noordwijk, Netherlands, HC 80 Dutch guilders

37 MECHANICAL ENGINEERING

Includes auxiliary systems (nonpower); machine elements and processes; and mechanical equipment.

N91-21525*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
CONNECTION SPACE REDUCTION MECHANISM Patent Application
Malcolm Bruce Milam, inventor (to NASA) 31 Dec. 1990 17 p
(NASA-Case-GSC-13220-1; NAS 1.71:GSC-13220-1;
US-Patent-Appl-SN-636532) Avail: NTIS HC/MF A03 CSCL 13I

A connector assembly comprised of two halves, each respectively including a shell type connector subassembly, one being an active half and the other being a passive half. The active half includes an alignment cusp that causes a coupling motion in response to coming in contact with the outer portion of the other half which causes the respective connectors within the

two subassemblies to move toward each other into coupling relationship at twice the rate at which the two subassemblies come together. Both halves are adapted to rotate about and translate along respective mutually orthogonal axes to facilitate an interconnection. NASA

N91-21526*# Vanderbilt Univ., Nashville, TN. Center for Materials Tribology.
ANALYSIS OF ROLLING CONTACT SPALL LIFE IN 440 C STEEL BEARING RIMS Final Report
P. C. Bastias, V. Bhargava, A. P. Bower, J. Du, V. Gupta, G. T. Hahn, S. M. Kulkarni, A. M. Kumar (Washington State Univ., Pullman.), X. Leng, and C. A. Rubin 23 Jan. 1991 274 p
(Contract NAS8-37764)
(NASA-CR-184101; NAS 1.26:184101) Avail: NTIS HC/MF A12 CSCL 13I

The results of a two year study of the mechanisms of spall failure in the HPOTP bearings are described. The objective was to build a foundation for detailed analyses of the contact life in terms of: cyclic plasticity, contact mechanics, spall nucleation, and spall growth. Since the laboratory rolling contact testing is carried out in the 3 ball/rod contact fatigue testing machine, the analysis of the contacts and contact lives produced in this machine received attention. The results from the experimentally observed growth lives are compared with calculated predictions derived from the fracture mechanics calculations. Author

N91-21527*# Stanford Univ., CA. Aerospace Robotics Lab.
CONTROL OF FREE-FLYING SPACE ROBOT MANIPULATOR SYSTEMS Semiannual Technical Report No. 9, Mar. - Aug. 1990
Robert H. Cannon, Jr. 1990 34 p
(Contract NCC2-333)
(NASA-CR-188026; NAS 1.26:188026) Avail: NTIS HC/MF A03 CSCL 13I

New control techniques for self contained, autonomous free flying space robots were developed and tested experimentally. Free flying robots are envisioned as a key element of any successful long term presence in space. These robots must be capable of performing the assembly, maintenance, and inspection, and repair tasks that currently require human extravehicular activity (EVA). A set of research projects were developed and carried out using lab models of satellite robots and a flexible manipulator. The second generation space robot models use air cushion vehicle (ACV) technology to simulate in 2-D the drag free, zero g conditions of space. The current work is divided into 5 major projects: Global Navigation and Control of a Free Floating Robot, Cooperative Manipulation from a Free Flying Robot, Multiple Robot Cooperation, Thrusterless Robotic Locomotion, and Dynamic Payload Manipulation. These projects are examined in detail. Author

N91-21528*# Stanford Univ., CA. Dept. of Aeronautics and Astronautics.
EXPERIMENTS IN THRUSTERLESS ROBOT LOCOMOTION CONTROL FOR SPACE APPLICATIONS Ph.D. Thesis
Warren Joseph Jasper Sep. 1990 110 p
(Contract NCC2-333)
(NASA-CR-188027; NAS 1.26:188027; SUDAAR-595) Avail: NTIS HC/MF A06 CSCL 13I

While performing complex assembly tasks or moving about in space, a space robot should minimize the amount of propellant consumed. A study is presented of space robot locomotion and orientation without the use of thrusters. The goal was to design a robot control paradigm that will perform thrusterless locomotion between two points on a structure, and to implement this paradigm on an experimental robot. A two arm free flying robot was constructed which floats on a cushion of air to simulate in 2-D the drag free, zero-g environment of space. The robot can impart momentum to itself by pushing off from an external structure in a coordinated two arm maneuver, and can then reorient itself by activating a momentum wheel. The controller design consists of two parts: a high level strategic controller and a low level dynamic controller. The control paradigm was verified experimentally by commanding the robot to push off from a structure with both arms, rotate 180 degs while translating freely, and then to catch itself on another structure. This method, based on the computed torque, provides a linear feedback law in momentum and its derivatives for a system of rigid bodies. Author

N91-21529*# Stanford Univ., CA. Aerospace Robotics Lab.
EXPERIMENTS IN COOPERATIVE-ARM OBJECT MANIPULATION WITH A TWO-ARMED FREE-FLYING ROBOT Ph.D. Thesis
Ross Koningstein Oct. 1990 217 p
(Contract NCC2-333)
(NASA-CR-188028; NAS 1.26:188028; SUDAAR-597) Avail: NTIS HC/MF A10 CSCL 13I

Developing computed-torque controllers for complex manipulator systems using current techniques and tools is difficult because they address the issues pertinent to simulation, as opposed to control. A new formulation of computed-torque (CT) control that leads to an automated computer-torque robot controller program is presented. This automated tool is used for simulations and experimental demonstrations of endpoint and object control from a free-flying robot. A new computed-torque formulation states the multibody control problem in an elegant, homogeneous, and practical form. A recursive dynamics algorithm is presented that numerically evaluates kinematics and dynamics terms for multibody systems given a topological description. Manipulators may be free-flying, and may have closed-chain constraints. With the exception of object squeeze-force control, the algorithm does not deal with actuator redundancy. The algorithm is used to implement an automated 2D computed-torque dynamics and control package that allows joint, endpoint, orientation, momentum, and object squeeze-force control. This package obviates the need for hand-derivation of kinematics and dynamics, and is used for both simulation and experimental control. Endpoint control experiments are performed on a laboratory robot that has two arms to manipulate payloads, and uses an air bearing to achieve very-low drag characteristics. Simulations and experimental data for endpoint and object controllers are presented for the experimental robot - a complex dynamic system. There is a certain rather wide set of conditions under which CT endpoint controllers can neglect robot base accelerations (but not motions) and achieve comparable performance including base accelerations in the model. The regime over which this simplification holds is explored by simulation and experiment. Author

N91-21530*# GenCorp Aerojet, Sacramento, CA. Propulsion Div.
MODELING OF ROLLING ELEMENT BEARING MECHANICS Monthly Report, Feb. 1991
L. M. Greenhill Feb. 1991 15 p
(Contract NAS8-38607)
(NASA-CR-188045; NAS 1.26:188045; KHK-10) Avail: NTIS HC/MF A03 CSCL 13I

Roller element bearings provide the primary mechanical interface between rotating and nonrotating components in the high performance turbomachinery of the Space Shuttle Main Engine (SSME). Knowledge of bearing behavior under various loading and environmental conditions is essential to predicting and understanding the overall behavior of turbopumps, including rotordynamic stability, critical speeds and bearing life. The objective is to develop mathematical models and computer programs to describe the mechanical behavior of ball and cylinder roller bearings under the loading and environmental conditions encountered in the SSME and future high performance rocket engines. This includes characteristics such as nonlinear load/motion relationships, stiffness and damping, rolling element loads for life prediction, and roller and cage stability. Author

N91-21531*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
ADVANCED ROTORCRAFT TRANSMISSION PROGRAM
Robert C. Bill 1990 18 p Presented at the 46th Annual American Helicopter Society Forum, Washington, DC, 21 May

1990 Previously announced in IAA as A91-17214 Prepared in cooperation with Army Aviation Systems Command, Cleveland, OH
(DA Proj. 1L1-62211-A-47-A)
(NASA-TM-103276; E-5722; NAS 1.15:103276;
AVSCOM-TR-90-C-015) Avail: NTIS HC/MF A03 CSCL 13I

The Advanced Rotorcraft Transmission (ART) program is an Army-funded, joint Army/NASA program to develop and demonstrate lightweight, quiet, durable drivetrain systems for next generation rotorcraft. ART addresses the drivetrain requirements of two distinct next generation aircraft classes: Future Air Attack Vehicle, a 10,000 to 20,000 lb. aircraft capable of undertaking tactical support and air-to-air missions; and Advanced Cargo Aircraft, a 60,000 to 80,000 lb. aircraft capable of heavy life field support operations. Both tiltrotor and more conventional helicopter configurations are included in the ART program. Specific objectives of ART include reduction of drivetrain weight by 25 percent compared to baseline state-of-the-art drive systems configured and sized for the next generation aircraft, reduction of noise level at the transmission source by 10 dB relative to a suitably sized and configured baseline, and attainment of at least a 5000 hr mean-time-between-removal. The technical approach for achieving the ART goals includes application of the latest available component, material, and lubrication technology to advanced concept drivetrains that utilize new ideas in gear configuration, transmission layout, and airframe/drivetrain integration. To date, candidate drivetrain systems were carried to a conceptual design stage, and tradeoff studies were conducted resulting in selection of an ART transmission configuration for each of the four contractors. The final selection was based on comparative weight, noise, and reliability studies. A description of each of the selected ART designs is included. Preliminary design of each of the four selected ART transmission was completed, as have mission impact studies wherein comparisons of aircraft mission performance and life cycle costs are undertaken for the next generation aircraft with ART and with the baseline transmission. Author

N91-21532*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
EVALUATION OF BEARING CONFIGURATIONS USING THE SINGLE BEARING TESTER IN LIQUID NITROGEN
T. Jett, P. Hall, and R. Thom Mar. 1991 85 p
(NASA-TM-103527; NAS 1.15:103527) Avail: NTIS HC/MF A05 CSCL 13I

Various bearing configurations were tested using the Marshall Space Flight Center single bearing tester with LN2 as the cryogenic coolant. The baseline was one Rocketdyne phase one high pressure oxidizer turbopump (HPOTP) pump end 45-mm bore bearing. The bearing configurations that were tested included a Salox/M cage configuration, a silicon nitride ball configuration, an elongated cage configuration, and a Bray 601 grease configuration. Author

N91-21533# Combustion Electromagnetics, Inc., Arlington, MA.
SPARK-IGNITED DIESEL ENGINE Final Technical Report, Apr. 1984 - Jul. 1990
Michael A. Ward 27 Nov. 1990 102 p
(Contracts DAAE07-84-C-R047; DAAE07-85-C-R054)
(AD-A230243; TACOM-TR-13502) Avail: NTIS HC/MF A06 CSCL 21/7

Conventional diesel engines suffer from problems of excessive weight and size and excessively high rates of pressure rise and peak pressure because of the requirement of very high-compression ratios for the purpose of ignition. They also lack multi fuel capability. The use of electrical or other precise ignition means obviates the dependence on high compression for ignition and would allow the diesel engine to operate at the more efficient and practical compression ratio of 12 to 1. To accomplish this, an innovative ignition system with an unusually high rate of energy delivery was used in conjunction with a modified diesel engine. This new design was found to provide approximately equal efficiency under most operating conditions other than high load, and to provide instant cold start at the more desirable compression ratio of between 11 to 12 to 1. However, problems of spark plug fouling by the fuel spray made this approach impractical for this specific application. Approaches for handling the problem of plug fouling have been suggested in this report. GRA

N91-21534*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
EFFECTS OF GEAR BOX VIBRATION AND MASS IMBALANCE ON THE DYNAMICS OF MULTI-STAGE GEAR TRANSMISSIONS
Fred K. Choy, Yu K. Tu (Akron Univ., OH.), James J. Zakrajsek, and Dennis P. Townsend Mar. 1991 33 p Prepared in cooperation with Army Aviation Systems Command, Cleveland, OH
(DA Proj. 1L1-62211-A-47-A)
(NASA-TM-103695; E-5916; NAS 1.15:103695;
AVSCOM-TR-90-C-022) Avail: NTIS HC/MF A03 CSCL 13I

The dynamic behavior of multistage gear transmission system, with the effects of gear-box-induced vibrations and rotor mass-imbalances is analyzed. The model method, using undamped frequencies and planar mode shapes, is used to reduce the degree-of-freedom of the system. The various rotor-bearing stages as well as lateral and torsional vibrations of each individual stage are coupled through localized gear-mesh-tooth interactions. Gear-box vibrations are coupled to the gear stage dynamics through bearing support forces. Transient and steady state dynamics of lateral and torsional vibrations of the geared system are examined in both time and frequency domain. A typical three-staged geared system is used as an example. Effects of mass-imbalance and gear box vibrations on the system dynamic behavior are presented in terms of modal excitation functions for both lateral and torsional vibrations. Operational characteristics and conclusions are drawn from the results presented. Author

N91-21535# Allied-Signal Aerospace Co., Kansas City, MO.
RESISTANCE SEAM WELDING THIN COPPER FOILS
D. L. Hollar, Jr. Feb. 1991 39 p Presented at the 72nd Annual American Welding Society Convention, Detroit, 14-19 Apr. 1991
(Contract DE-AC04-76DP-00613)
(DE91-008988; KCP-613-4380; CONF-9104195-1) Avail: NTIS HC/MF A03

Use of flat flexible circuits in the electronics industry is expanding. The term 'flexible circuits' is defined here as copper foil which has been bonded to an insulating film such as Kapton film. The foil is photo-processed to produce individual circuit paths similar to printed circuit boards. Another insulating film is laminated over the conductors to complete the flexible circuit. Flexible circuits, like multiwire cables, are susceptible to electromagnetic radiation (EMR) interference. On multiwire cables the interference problem is mitigated by adding a woven wire braid shielding over the conductors. Shielding on flexible circuits is accomplished by enclosing the circuits in a copper foil envelope. However, the copper foil must be electrically sealed around the flexcircuit to be effective. Ultimately, a resistance seam welding process and appropriate equipment were developed which would provide the required electrical seal between two layers of 2-oz (0.0028-inch thick) copper foil on a 1.1-inch wide, 30-inch long, 0.040-inch thick flexible circuit. DOE

N91-21536# Sandia National Labs., Albuquerque, NM.
A COMPARISON OF CALCULATIONAL RESULTS WITH EXPERIMENTAL DATA FOR LONG ROD PROJECTILES
E. S. Hertel, Jr. Dec. 1990 35 p
(Contract DE-AC04-76DP-00789)
(DE91-009006; SAND-90-0610) Avail: NTIS HC/MF A03

Calculations were performed with CTH (a finite difference hydrodynamics code) to evaluate computational capabilities for predicting residual projectile length and position in high velocity penetration events. The calculations simulated selected tests in a set of armor penetration experiments conducted and reported by Los Alamos National Laboratory. The tests and simulations involved penetration of armor ranging from 6.4 to 50.8 mm in thickness by

long rod projectiles over a range of velocities from 1.0 to 1.29 km/sec. Comparisons are made between the calculated and measured final projectile lengths and positions, and the sensitivity of the predicted results to target and projectile property variations is investigated. DOE

N91-21537 ESDU International Ltd., London (England).
FRICTIONAL AND RETARDING FORCES ON AIRCRAFT TYRES. PART 5: ESTIMATION OF FLUID DRAG FORCES Abstract Only
Nov. 1990 36 p
(ESDU-90035; ISBN-0-85679-761-8; ISSN-0141-4054) Avail: ESDU

ESDU 90035 provides methods for estimating the drag experience by aircraft tires running in a layer of water or slush (with specific gravity down to 0.8) on a runway. The configurations covered are a single tire, twin-tires (side by side), twin tires in tandem, dual-tandem tires (two pairs of twin-tires one behind the other), a single row of multiple tires side by side, and two such rows one behind the other. The effects of yaw and of tire spray alleviators are also considered. The estimated values exclude the drag of the undercarriage upper leg above the axle or undercarriage chassis and forces due to spray impingement on any other undercarriage or other parts of the airframe. The methods use graphically presented empirical factors applied to the single wheel drag. The single wheel drag is also empirically derived and presented graphically as a function of speed (as a fraction of the planing speed) and deflected tire width at the runway and at the liquid surface (for which estimation procedures are also given). The derivation of the methods is fully discussed, together with sketches showing the comparison between estimated and test values drawn from the available literature. Worked examples illustrate the use of the methods for typical twin-tire and dual-tandem undercarriages. Estimates are also made for the undercarriage drag of the Convair 880 in slush over a range of speeds and are compared with the widely-quoted set of full-scale test measurements. ESDU

N91-21538# National Aerospace Lab., Tokyo (Japan).
EFFECTIVE CLEANING OF OIL-PROTECTED BEARING STEEL EXAMINED BY XPS ANALYSIS. PART 1: CLEANING BY SOLVENTS AND ALKALINE CLEANERS
M. Nishimura and A. Matsui Jul. 1990 21 p In JAPANESE; ENGLISH summary
(NAL-TR-1074; ISSN-0389-4010) Avail: NTIS HC/MF A03

Tribological properties of solid lubricant films, wear life in particular, depend on film/substrate adherence which is, in turn, dependent on the cleanliness of a substrate. Even after thorough cleaning by various solvents, a trace of antirust oil can remain on a steel surface and prevent strong adhesion of a film to a substrate. Thus the importance of effective cleaning is recognized. Bearing steels protected by an oil film containing barium sulphonate as an antirust agent were subjected to a variety of cleaning procedures using various solvents and alkaline cleaners. Types and levels of contamination caused by the oil, and by cleaners as well, were measured by use of an XPS apparatus. Obtained results are summarized as follows: (1) All cleaning procedures tested failed to remove an antirust agent layer from surfaces of bearing steel. Procedures including alkaline cleaners provided an expection: they were able to expose steel surfaces completely. (2) Contaminations with Na and C-OH were confirmed on steel surfaces after they were treated by alkaline cleaning. These contaminants were taken away by ultrasonic cleaning with ethanol. (3) Vapor degreasing with isopropanol caused carbon contamination. (4) The thickness of an antirust agent layer which remains on a bearing surface even after thorough cleaning with solvents is estimated to be about 2 nm. This corresponds to the thickness of a single molecular layer of barium sulphonate. Author

N91-21539* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
SINGLE ELEMENT MAGNETIC SUSPENSION ACTUATOR Patent
Nelson J. Groom, inventor (to NASA) 26 Mar. 1991 9 p Filed 11 Sep. 1989 Supersedes N90-15442 (28 - 7, p 940)
(NASA-Case-LAR-13981-1; US-Patent-5,003,235; US-Patent-Appl-SN-405154; US-Patent-Class-318-135; US-Patent-Class-310-90.5; Int-Patent-Class-H02K-41/00) Avail: US Patent and Trademark Office CSCL 13I

The invention, a single element magnetic suspension actuator with bidirectional force capability along a single axis, includes an electromagnet and a nonmagnetic suspended element. A permanent magnet mounted on the suspended element interacts with a magnetic field established by the electromagnet to produce bidirectional forces in response to a variable force command voltage V (sub FC) applied to the electromagnet. A sensor measures the position of the suspended element on the single axis which is a function of force command voltage V (sub FC). NASA

N91-21540* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
FULLY ARTICULATED FOUR-POINT-BEND LOADING FIXTURE Patent
Anthony M. Calomino, inventor (to NASA) 22 Jan. 1991 7 p Filed 28 Dec. 1989 Supersedes 90N-15445 (28 - 7, p 940)
(NASA-Case-LEW-14776-1; US-Patent-4,986,132; US-Patent-Appl-SN-458274; US-Patent-Class-73-852; Int-Patent-Class-G01N-3/20) Avail: US Patent and Trademark Office CSCL 13I

A fully articulated four-point bend loading fixture for Modulus of Rupture (MOR) and fracture toughness specimens utilizes an upper loading plate in combination with a lower loading plate. The lower plate has a pair of spring loaded ball bearings which seat in V-shaped grooves located in the upper plate. The ball bearings are carried in the arms of the lower plate. A load is applied to the specimen through steel rollers, one large roller and one smaller roller each located on both the upper and lower plates. The large rollers have needle roller bearings which enable a single loading roller to rotate relative to the plate to which it is attached.
Official Gazette of the U.S. Patent and Trademark Office

N91-21541* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
MECHANICAL STRAIN ISOLATOR MOUNT Patent
Gordon E. James, inventor (to NASA) (TRW Space Technology Labs., Redondo Beach, CA.) 5 Mar. 1991 4 p Filed 27 Nov. 1989 Supersedes N90-16272 (28 - 8, p 1084)
(NASA-Case-LAR-13580-1; US-Patent-4,997,158; US-Patent-Appl-SN-441673; US-Patent-Class-248-604; US-Patent-Class-248-593; Int-Patent-Class-F16M-13/00) Avail: US Patent and Trademark Office CSCL 13I

Certain devices such as optical instruments must preserve their alignmental integrity while being subjected to mechanical strain. A mechanical strain isolator mount is provided to preserve the alignmental integrity of an alignment sensitive instrument. An alignment sensitive instrument is mounted on a rectangular base. Flexural legs are connected at their proximal ends to the rectangular base. Flexural legs are also spaced parallel to the sides. Mounting pads are connected to the legs at the distal end and the mechanical strain isolator mount is attached to the substrate by means of threaded bolts. When a mounting pad and its respective leg is subjected to lateral strain in either the X or Y direction via the substrate, the respective leg relieves the strain by bending in the direction of the strain. An axial strain on a mounting pad in the Z direction is relieved by a rotational motion of the legs in the direction of the strain. When the substrate is stress free, the flexural legs return to their original condition and thus preserve the original alignment integrity of the alignment sensitive instrument. NASA

N91-21542* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
METHOD AND APPARATUS FOR POSITIONING A ROBOTIC END EFFECTOR Patent
Clifford W. Hess, inventor (to NASA) and Larry C. H. Li, inventor (to NASA) 25 Dec. 1990 14 p Filed 10 Aug. 1989 Supersedes

N90-17137 (28 - 9, p 1230)
(NASA-Case-MSC-21476-1; US-Patent-4,980,626;
US-Patent-Appl-SN-392235; US-Patent-Class-318-568.16;
US-Patent-Class-318-568.21; US-Patent-Class-318-568.20;
US-Patent-Class-901-33; US-Patent-Class-901-37;
US-Patent-Class-901-47; US-Patent-Class-364-513) Avail: US Patent and Trademark Office CSCL 13I

A robotic end effector and operation protocol for a reliable grasp of a target object irrespective of the target's contours is disclosed. A robotic hand includes a plurality of jointed fingers, one of which, like a thumb, is in opposed relation to the other. Each finger is comprised of at least two jointed sections, and provided with reflective proximity sensors, one on the inner surface of each finger section. Each proximity sensor comprises a transmitter of a beam of radiant energy and means for receiving reflections of the transmitted energy when reflected by a target object and for generating electrical signals responsive thereto. On the fingers opposed to the thumb, the proximity sensors on the outermost finger sections are aligned in an outer sensor array and the sensors on the intermediate finger sections and sensors on the innermost finger sections are similarly arranged to form an intermediate sensor array and an inner sensor array, respectively. The invention includes a computer system with software and/or circuitry for a protocol comprising the steps in sequence of: (1) approach axis alignment to maximize the number of outer layer sensors which detect the target; (2) non-contact contour following the target by the robot fingers to minimize target escape potential; and (3) closing to rigidize the target including dynamically re-adjusting the end effector finger alignment to compensate for target motion. A signal conditioning circuit and gain adjustment means are included to maintain the dynamic range of low power reflection signals.

Official Gazette of the U.S. Patent and Trademark Office

N91-21543* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
ALIGNMENT POSITIONING MECHANISM Patent
Peter M. Fantasia, inventor (to NASA) 19 Mar. 1991 9 p Filed 26 Jan. 1990 Supersedes N90-26341 (28 - 20, p 2872)
(NASA-Case-MSC-21502-1; US-Patent-5,000,416;
US-Patent-Appl-SN-470663; US-Patent-Class-248-650;
US-Patent-Class-248-677; US-Patent-Class-248-181;
US-Patent-Class-254-101; US-Patent-Class-DIG.4;
US-Patent-Class-403-131; Int-Patent-Class-F16M-13/00) Avail: US Patent and Trademark Office CSCL 13I

An alignment positioning mechanism for correcting and compensating for misalignment of structures to be coupled is disclosed. The mechanism comprises a power screw with a base portion and a threaded shank portion. A mounting fixture is provided for rigidly coupling said base portion to the mounting interface of a supporting structure with the axis of the screw perpendicular thereto. A traveling ball nut threaded on the power screw is formed with an external annular arcuate surface configured in the form of a spherical segment and enclosed by a ball nut housing with a conforming arcuate surface for permitting gimballed motion thereon. The ball nut housing is provided with a mounting surface which is positionable in cooperable engagement with the mounting interface of a primary structure to be coupled to the supporting structure. Cooperative means are provided on the ball nut and ball nut housing, respectively, for positioning the ball nut and ball nut housing in relative gimballed position within a predetermined range of relative angular relationship whereby severe structural stresses due to unequal loadings and undesirable bending moments on the mechanism are avoided.

Official Gazette of the U.S. Patent and Trademark Office

N91-21544* National Aeronautics and Space Administration. Pasadena Office, CA.
METHOD AND APPARATUS FOR CONFIGURATION CONTROL OF REDUNDANT ROBOTS Patent
Homayoun Seraji, inventor (to NASA) (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) 12 Mar. 1991 22 p Filed 28 Dec. 1989 Supersedes N90-27110 (28 - 21, p 3010)
(Contract NAS7-918)
(NASA-Case-NPO-17801-1-CU; US-Patent-4,999,553;
US-Patent-Appl-SN-459029; US-Patent-Class-318-561;
US-Patent-Class-318-646; US-Patent-Class-318-648;
US-Patent-Class-318-628; US-Patent-Class-364-478;
US-Patent-Class-364-513; US-Patent-Class-901-9) Avail: US Patent and Trademark Office CSCL 13I

A method and apparatus to control a robot or manipulator configuration over the entire motion based on augmentation of the manipulator forward kinematics is disclosed. A set of kinematic functions is defined in Cartesian or joint space to reflect the desirable configuration that will be achieved in addition to the specified end-effector motion. The user-defined kinematic functions and the end-effector Cartesian coordinates are combined to form a set of task-related configuration variables as generalized coordinates for the manipulator. A task-based adaptive scheme is then utilized to directly control the configuration variables so as to achieve tracking of some desired reference trajectories throughout the robot motion. This accomplishes the basic task of desired end-effector motion, while utilizing the redundancy to achieve any additional task through the desired time variation of the kinematic functions. The present invention can also be used for optimization of any kinematic objective function, or for satisfaction of a set of kinematic inequality constraints, as in an obstacle avoidance problem. In contrast to pseudoinverse-based methods, the configuration control scheme ensures cyclic motion of the manipulator, which is an essential requirement for repetitive operations. The control law is simple and computationally very fast, and does not require either the complex manipulator dynamic model or the complicated inverse kinematic transformation. The configuration control scheme can alternatively be implemented in joint space.

Official Gazette of the U.S. Patent and Trademark Office

N91-21545* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
SAMPLE HOLDER SUPPORT FOR MICROSCOPES Patent
Anthony Berry, inventor (to NASA) and Billy H. Nerren, inventor (to NASA) 1 Jan. 1991 4 p Filed 15 May 1990 Supersedes N90-27113 (28 - 21, p 3010)
(NASA-Case-MFS-28420-1; US-Patent-4,981,345;
US-Patent-Appl-SN-523675; US-Patent-Class-350-529;
US-Patent-Class-269-21; Int-Patent-Class-G02B-21/26;
Int-Patent-Class-G02B-21/32; Int-Patent-Class-B25B-11/00)
Avail: US Patent and Trademark Office CSCL 13I

A sample filter holder is disclosed for use with a microscope for holding the filter in a planar condition on the stage of the microscope so that automatic focusing of the microscope can be performed on particle samples dispersed on the filter. The holder includes a base having a well that communicates with an inlet port which is connected to a suction pump. A screen assembly is positioned within the well. The screen assembly includes a disk having a screen positioned on its top surface and secured to the disk at the peripheral edge of the screen. Small bores allow the outer surface of the screen to communicate with the well. The filter is placed on the screen and is held in a flat disposition by the suction forces.

Official Gazette of the U.S. Patent and Trademark Office

N91-21546# Technical Research Centre of Finland, Espoo. Polttoainetekniikan Laboratorio.
USE OF NATURAL GAS AND LIQUEFIED PETROLEUM GAS IN HEAVY-DUTY ENGINES
Nils-Olaf Nylund, Matti Kytoe, and Tom Eklund Nov. 1990 76 p In FINNISH; ENGLISH summary
(DE91-752990; VTT-TIED-1187; ISBN-951-38-3905-2;
ISSN-0358-5085) Avail: NTIS HC/MF A05

Exhaust gas emissions from heavy-duty vehicles will be reduced in the 1990s to the level hardly achievable with conventional diesel technique. Alternative uses of natural gas and liquefied petroleum gas (LPG) and experiences from their use as the fuel of heavy-duty vehicles are reviewed in this note mainly with reference to literature and, to a minor extent, to own experiments. Natural gas and LPG

are good engine fuels. As regards LPG, only propane can be used in Finland's climate. These gases are used nearly exclusively in spark-ignition engines, but can also be used in stationary engines as the main fuel of the diesel engine. The greatest problems relate to their rather low energy density and high storage pressure. The fuel tanks are pressure vessels and require a lot of space. The output of uncharged gas engines is higher than that of corresponding diesels, but lower than of charged diesels. The spark-ignition engines of heavy vehicles are nearly without exception based on diesel engines. The simplest modification requires reduction in compression ratio and construction of an ignition system and gas feed. It is easy to change an otto engine modified from a diesel in a vehicle, as changes are required only in the motor. The cleanest exhaust gases are obtained from a gas engine equipped with a threeway catalyst. Very clean exhaust gases are also achieved with leanblend engines compared to those of a diesel. The exhaust gases of the gas engines contain a very low amount of particles, while, for example, an engine operating on a stoichiometric blend ratio produces an abundance of gaseous emission components, if the exhaust gases are not cleaned up catalytically. In an engine equipped with a threeway catalyst, natural gas and LPG are equal fuels with regard to the purity of exhaust gases. DOE

N91-21547# Aerospace Corp., El Segundo, CA. Lab. Operations.
TRIBOLOGICAL PERFORMANCE AND DEFORMATION OF SPUTTER-DEPOSITED MoS2 SOLID LUBRICANT FILMS DURING SLIDING WEAR AND INDENTATION CONTACT
M. R. Hilton, R. Bauer, and P. D. Fleischauer 15 Dec. 1990 41 p
(Contract F04701-88-C-0089)
(AD-A231003; TR-0089(4945-03)-4; SSD-TR-90-52) Avail: NTIS HC/MF A03 CSCL 11/8

Microstructural aspects of the plastic deformation of sputter-deposited MoS2 solid lubricant films on 440 C bearing steel are presented. The films were produced in three different laboratories using radio frequency, direct current, and radio frequency magnetron sources. Two-types of contacts were investigated: (1) sliding wear contact in a thrust-washer apparatus used to evaluate film tribological performance, and (2) brale indentation contact used to investigate cross-sectional morphology and adhesion. Scanning electron microscopy, x ray diffraction, Auger electron spectroscopy, and x ray photoelectron spectroscopy were used to characterize the films. The as-deposited morphology was found to influence the initial nature of the wear debris and the load-bearing capabilities of the films. In many cases, a highly deformed region confined to the surface of the films was found. Applied stress reoriented crystallites and induced crystallization. The degree of both processes was related to the initial structure and the percentage of wear lifetime of the film. GRA

N91-21548# North Carolina Agricultural and Technical State Univ., Greensboro. Dept. of Mechanical Engineering.
STUDIES OF A DIRECT DRIVE ROBOT WITH A PARALLEL CONFIGURATION Final Report, 1 Sep. 1989 - 30 Sep. 1990
Shih-Liang Wang 29 Nov. 1990 13 p
(Contract DAAL03-89-G-0109)
(AD-A231265; ARO-27246.1-EG-SAH) Avail: NTIS HC/MF A03 CSCL 12/9

A new, light weight, six degrees of freedom, direct drive robot is studied. The robot has a dual-arm, or a semi-parallel configuration, and it has the characteristics between those of a serial robot and those of a parallel robot. That is, it has a large payload-to-weight ratio and high stiffness of a parallel robot and a large workspace, compact structure, and simple control algorithm of a serial robot. Because of the use of direct drive motors and composite materials, the robot is light weight and has high precision. Different robot configurations are synthesized for different motion requirements. Motion and force analysis are carried out in the project, and motion simulation programs are completed. Possible army applications are explored. GRA

N91-21549# Iowa Univ., Iowa City. Dept. of Computer Science.
GENERALIZING THE HOP: OBJECT-LEVEL PROGRAMMING FOR LEGGED MOTION
J. K. Kearney and S. Hansen Aug. 1990 20 p
(Contract N00014-88-K-0632; NSF IRI-88-08896)
(AD-A231315; TR-90-07) Avail: NTIS HC/MF A03 CSCL 12/5

This paper presents a model-independent method for controlling a hopping robot. The approach focuses on the interaction between the hopper and its surrounding at points of contact. It is only through reactions at contact points that a hopper can alter its momenta. A generalization of the virtual leg abstraction allows control programs to be expressed as constraints on the external forces and torques acting on the hopper. The relationship between the nature external contacts and motion control strategies is investigated. The results of simulations for a variety of hoppers are presented. GRA

N91-21550# Cornell Univ., Ithaca, NY. Dept. of Computer Science.
A PLANE-SWEEP ALGORITHM FOR EXACT SIMULATION OF A QUASI-STATIC MECHANICAL SYSTEM OF COMPLIANTLY-CONNECTED RIGID BODIES (EXTENDED ABSTRACT)
Bruce R. Donald and Dinesh K. Pai Dec. 1990 16 p
(Contracts N00014-88-K-0591; N00014-89-J-1946; NSF DMO-86-17355)
(AD-A231324; TR-90-1177) Avail: NTIS HC/MF A03 CSCL 13/5

Automatic fastening (e.g., snap fasteners) is a central theme in Computer Aided Design, manufacturing and design for assembly. Snap fasteners are non-rigid bodies, and hence predicting the motion of flexible objects during an assembly is of interest as an algorithmic problem. A planar system of rigid bodies that are compliantly connected by torsional springs was considered. A single root body undergoes pure translation, during which k passively rotationally compliant members called pawls can contact with immovable planar obstacles. As the motion proceeds, the pawls deform (deflect) around the obstacles in response to the kinetic constraints and the frictional contact forces. The pawls can also snap off an obstacle edge towards their zero position; this motion is modeled using a pure rotation. The simulation problem is to determine the motion of the pawls as parameterized by the translation distance of the root, and to compute the termination configuration of the system if it is reachable. GRA

N91-21551# Naval Postgraduate School, Monterey, CA.
AN ECONOMIC ANALYSIS OF COUNTERFEIT THREADED FASTENERS IN THE CONSTRUCTION INDUSTRY M.S. Thesis
Bruce D. Amidon Jun. 1990 58 p
(AD-A231492) Avail: NTIS HC/MF A04 CSCL 13/5

This thesis deals with the economic issues associated with the presence of substandard threaded fasteners in the construction industry. It begins with an overview of the engineering concepts and terminology which will be used throughout the remainder of the report. A short discussion is presented outlining the various mechanical forces which act upon these fasteners in order to develop an appreciation for the seriousness of the problem. Past and present problems within the fastener industry and market are also covered. The problem is then thoroughly analyzed through the use of mathematical models. The concepts of zero-sum and non-zero sum two player game theory are used to provide possible solutions to the problem. GRA

38 QUALITY ASSURANCE AND RELIABILITY

Includes product sampling procedures and techniques; and quality control.

N91-21552# Air War Coll., Maxwell AFB, AL.
TOP QUALITY MANAGEMENT, RELIABILITY, AND MAINTAINABILITY: INSTITUTIONAL GOALS WITH BUILT IN BARRIERS
Philip B. Aitken-Cade 1990 71 p
(AD-A230134) Avail: NTIS HC/MF A04 CSCL 05/1

Total quality management (TQM) has been heralded as the process that will finally cause a cultural change throughout government and industry to usher in a new era of continuously increasing quality. Since the system appears to be slow to react to the change in culture, there may be institutional impediments that are preventing the Air Force from achieving all that it can in reliability and maintainability (R and M) and TQM. However, the study concludes that there are no concrete institutional barriers preventing the Air Force from reaching the goal of TQM. There are only opportunities for senior leaders to demonstrate their commitment to the TQM program. All members of the Air Force and industry must work toward continuous improvement in all facets of the system and the senior leaders must set the pace. Industry has instituted various forms of TQM (after all, TQM is defined in many different ways) and does not need the Government to dictate implementation plans. The success of the Air Force TQM program will depend on the extent to which its senior leaders are prepared to apply the concept of KAIZEN - gradual, unending improvement, doing little things better; setting and achieving ever-higher standards. GRA

N91-21553*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
SPATIAL VARIATIONS IN ac SUSCEPTIBILITY AND MICROSTRUCTURE FOR THE YBa2Cu3O(7-x) SUPERCONDUCTOR AND THEIR CORRELATION WITH ROOM-TEMPERATURE ULTRASONIC MEASUREMENTS
Don J. Roth, Mark R. DeGuire, Leonard E. Dolhert (Grace, W. R. and Co., Columbia, MD), and Alonysius F. Hepp May 1991 22 p Presented at the 93rd Annual Meeting of the American Ceramic Society, Cincinnati, OH, 28 Apr. - 2 May 1991
(NASA-TM-103787; E-6064; NAS 1.15:103787) Avail: NTIS HC/MF A03 CSCL 14D

The spatial (within-sample) uniformity of superconducting behavior and microstructure in YBa2Cu3O(7-x) specimens over the pore fraction range of 0.10 to 0.25 was examined. The viability of using a room-temperature, nondestructive characterization method (ultrasonic velocity imaging) to predict spatial variability was determined. Spatial variations in superconductor properties were observed for specimens containing 0.10 pore fraction. An ultrasonic velocity image constructed from measurements at 1 mm increments across one such specimen revealed microstructural variation between edge and center locations that correlated with variations in alternating-current shielding and loss behavior. Optical quantitative image analysis on sample cross-sections revealed pore fraction to be the varying microstructural feature. Author

N91-21554# Lawrence Livermore National Lab., CA.
NONDESTRUCTIVE IMAGING OF MATERIALS MICROSTRUCTURE USING X RAY TOMOGRAPHIC MICROSCOPY
J. H. Kinney, R. A. Saroyan, M. C. Nichols, U. Bonse, S. R. Stock, T. M. Breunig, and A. Guvenilir (Dortmund Univ., Germany, F.R.) Nov. 1990 17 p Presented at the Fall Meeting of the Materials Research Society, Boston, 24 Nov. - 1 Dec. 1990
(Contract W-7405-eng-48)
(DE91-008505; UCRL-JC-106127; CONF-901105-97) Avail: NTIS HC/MF A03

A technique for nondestructively imaging microstructures of materials in-situ, especially a technique capable of delineating the time evolution of chemical changes or damage, will greatly benefit studies of materials processing and failure. X-ray tomographic microscopy (XTM) is a high resolution, three-dimensional inspection method which is capable of imaging composite materials microstructures with a resolution of a few micrometers. Because XTM is nondestructive, it will be possible to examine materials under load or during processing, and obtain three-dimensional images of fiber positions, microcracks, and pores. This will allow direct imaging of microstructural evolution, and will provide time-dependent data for comparison to fracture mechanics and processing models. DOE

N91-21555# Air Force Human Resources Lab., Wright-Patterson AFB, OH.
DECISION SUPPORT ENVIRONMENT FOR CONCURRENT ENGINEERING REQUIREMENTS Final Technical Paper
Raymond R. Hill, Jr. Jan. 1991 61 p
(AD-A230899; AFHRL-TP-90-89) Avail: NTIS HC/MF A04 CSCL 05/1

The results are presented of internal Air Force Human Resources Laboratory (AFHRL) research investigating the potential applications of Quality Function Deployment (QFD) to Concurrent Engineering (CE). Influences from the Total Quality Management (TQM) initiative, as well as CE, have increased acquisition emphasis on customer satisfaction and proper definition of the Voice of the Customer. In weapon system acquisition the combat command's requirements are the voice of the customer and it is their needs and requirements that must be captured, defined, and satisfied. To help achieve this goal, as well as TQM and CE goals of improved acquisition efficiency and effectiveness, this research investigated the weapon system requirements process. A decision support environment accommodating the requirements process and incorporating the methods and tools will enhance CE through the earliest parts of design, the definition of the weapon system requirements, and the needs upon which those requirements are based. A finding of the research was QFD could be used as a paradigm for a Decision Support System (DSS) environment to incorporate the investigated methods, and thereby enhance the requirements definition, analysis, and management aspects of weapon system acquisition. GRA

39 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; and thermal stress.

For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance.*

N91-21556*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
DETERMINATION OF THE FLIGHT HARDWARE CONFIGURATION OF AN ENERGY ABSORBING ATTENUATOR FOR THE PROPOSED SPACE STATION CREW AND EQUIPMENT TRANSLATION AID CART
Edwin L. Fasanella, Karen E. Jackson (Army Aviation Research and Development Command, Hampton, VA.), Lisa E. Jones, and John E. Teter, Jr. [1991] 58 p
(NASA-TP-3084; L-16852; NAS 1.60:3084) Avail: NTIS HC/MF A04 CSCL 20K

A device incorporating a crushable honeycomb column as the energy dissipating mechanism was designed as an emergency stopping device for the crew and equipment translation aid (CETA) cart. The CETA cart is designed to transport astronauts along a monorail on the space station. Impact tests were performed to determine which honeycomb design provided a stopping force of 100 lbs and energy dissipation of at least 1650 in-lbs for 16.5 inches of stroke. A typical honeycomb column consisted of four 5 7/8 inch long segments of 75 psi honeycomb, separated by 1.5 inch diameter washers. The impact load was provided by a mass which was dropped from a sufficient height to provide 1/2 the equivalent energy of one astronaut plus equipment (500 lbs total) moving at 6 ft/sec. Specimen configurations having aluminum,

polyethylene, and teflon washers were tested. Based on the results of impact tests, a honeycomb energy absorbing column with standard core, foil wrapping, and teflon washers was chosen for the CETA flight experiment. Author

N91-21557*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Engineering Science and Mechanics.
LARGE DEFORMATION BEHAVIOR OF LONG SHALLOW CYLINDRICAL COMPOSITE PANELS Interim Report, 1 Sep. 1982 - 31 Aug. 1983
Douglas M. Carper, Michael W. Hyer, and Eric R. Johnson Washington NASA Apr. 1991 171 p
(Contract NCC1-15)
(NASA-CR-4355; NAS 1.26:4355; VPI-E-83-37) Avail: NTIS HC/MF A08 CSCL 20K

An exact solution is presented for the large deformation response of a simply supported orthotropic cylindrical panel subjected to a uniform line load along a cylinder generator. The cross section of the cylinder is circular and deformations up to the fully snapped through position are investigated. The orthotropic axes are parallel to the generator and circumferential directions. The governing equations are derived using laminated plate theory, nonlinear strain-displacement relations, and applying variational principles. The response is investigated for the case of a panel loaded exactly at midspan and for a panel with the load offset from midspan. The mathematical formulation is one dimensional in the circumferential coordinate. Solutions are obtained in closed-form. An experimental apparatus was designed to load the panels. Experimental results of displacement controlled tests performed on graphite-epoxy curved panels are compared with analytical predictions. Author

N91-21558*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
ELASTIC RESPONSE OF ZONE AXIS (001)-ORIENTED PWA 1480 SINGLE CRYSTAL: THE INFLUENCE OF SECONDARY ORIENTATION
Sreeramesh Kalluri, Ali Abdul-Aziz (Sverdrup Technology, Inc., Brook Park, OH.), and Michael A. McGaw 1991 13 p Presented at the 1991 Aerospace Atlantic Meeting, Dayton, OH, 23-26 Apr. 1991; sponsored by SAE
(Contract NAS3-25266)
(NASA-TM-103782; E-6057; NAS 1.15:103782) Avail: NTIS HC/MF A03 CSCL 20K

The influence of secondary orientation on the elastic response of a zone axis (001)-oriented nickel-base single-crystal superalloy, PWA 1480, was investigated under mechanical loading conditions by applying finite element techniques. Elastic stress analyses were performed with a commercially available finite element code. Secondary orientation of the single-crystal superalloy was offset with respect to the global coordinate system in increments from 0 to 90 deg and stresses developed within the single crystal were determined for each loading condition. The results indicated that the stresses were strongly influenced by the angular offset between the secondary crystal orientation and the global coordinate system. The degree of influence was found to vary with the type of loading condition (mechanical, thermal, or combined) imposed on the single-crystal superalloy. Author

N91-21559*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
APPLICATIONS OF ARTIFICIAL NEURAL NETS IN STRUCTURAL MECHANICS
Laszlo Berke and Prabhat Hajela (Rensselaer Polytechnic Inst., Troy, NY.) 1990 22 p Presented at the Lecture Series on Shape and Layout Optimization of Structural Systems, Udine, Italy, 16-20 Jul. 1990
(NASA-TM-102420; E-5941; NAS 1.15:102420) Avail: NTIS HC/MF A03 CSCL 20K

A brief introduction to the fundamental of Neural Nets is given, followed by two applications in structural optimization. In the first case, the feasibility of simulating with neural nets the many structural analyses performed during optimization iterations was studied. In the second case, the concept of using neural nets to capture design expertise was studied. Author

N91-21560*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Composite Materials and Structures.
THERMAL BUCKLING AND POSTBUCKLING OF SYMMETRICALLY LAMINATED COMPOSITE PLATES Interim Report No. 84
Carol A. Meyers, Michael W. Hyer, and Mark J. Shuart (National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.) Feb. 1991 153 p
(Grant NAG1-343)
(NASA-CR-188030; NAS 1.26:188030; CCMS-91-06; VPI-E-91-03) Avail: NTIS HC/MF A08 CSCL 20K

An investigation into thermal buckling and postbuckling of symmetrically laminated composite plates is discussed. Thermal buckling is investigated for laminates under two different simple support conditions, fixed and sliding. These laminates are subjected to the conditions of a uniform temperature change and a linearly varying temperature change and nonlinear response to imperfections in the form of a thermal gradient through the thickness of the plate and a lack of initial flatness are also studied. The buckling response is studied using variational methods, specifically the Trefftz criterion. Postbuckling and responses to imperfections are studied using nonlinear equilibrium conditions. A Rayleigh-Ritz formulation is used to obtain numerical results from the formulations for the prebuckling response, the buckling response, and the postbuckling and imperfection responses. The analyses are applied to graphite-reinforced materials with (+ or - 45/0(sub 2))s and (+ or - 45/0/90)s lamination sequences. Numerical results are obtained for these laminates and also for the case of these laminates being rotated 30 deg inplane. For the first laminate, for example, such a rotation results in a (+75/-15/30(sub 2))s stacking sequence. Such skewing of the principal material directions may be encountered when using fiber-reinforced materials in a structurally tailored design. In addition, the influence on thermal buckling of a lack of ideal boundary conditions in the form of boundary compliance and thermal expansion, which would occur in any real set-up, are investigated. Author

N91-21561*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Composite Materials and Structures.
A METHOD FOR THE GEOMETRICALLY NONLINEAR ANALYSIS OF COMPRESSIVELY LOADED PRISMATIC COMPOSITE STRUCTURES
Frederick Stoll, Zafer Gurdal, and James H. Starnes, Jr. Feb. 1991 223 p
(Grant NAG1-343)
(NASA-CR-184846; NAS 1.26:184846; CCMS-91-03; VPI-E-91-01) Avail: NTIS HC/MF A10 CSCL 20K

A method was developed for the geometrically nonlinear analysis of the static response of thin-walled stiffened composite structures loaded in uniaxial or biaxial compression. The method is applicable to arbitrary prismatic configurations composed of linked plate strips, such as stiffened panels and thin-walled columns. The longitudinal ends of the structure are assumed to be simply supported, and geometric shape imperfections can be modeled. The method can predict the nonlinear phenomena of postbuckling strength and imperfection sensitivity which are exhibited by some buckling-dominated structures. The method is computer-based and is semi-analytic in nature, making it computationally economical in comparison to finite element methods. The method uses a perturbation approach based on the use of a series of buckling mode shapes to represent displacement contributions associated with nonlinear response. Displacement contributions which are of second order in the model amplitudes are incorported in addition to the buckling mode shapes. The principle of virtual work is applied using a finite basis of buckling modes, and terms through the third order in the model amplitudes are retained. A set of cubic nonlinear algebraic equations are obtained, from which approximate equilibrium solutions are

determined. Buckling mode shapes for the general class of structure are obtained using the VIPASA analysis code within the PASCO stiffened-panel design code. Thus, subject to some additional restrictions in loading and plate anisotropy, structures which can be modeled with respect to buckling behavior by VIPASA can be analyzed with respect to nonlinear response using the new method. Results obtained using the method are compared with both experimental and analytical results in the literature. The configurations investigated include several different unstiffened and blade-stiffening panel configurations, featuring both homogeneous, isotropic materials, and laminated composite material. Author

N91-21562*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
HITCAN FOR ACTIVELY COOLED HOT-COMPOSITE THERMOSTRUCTURAL ANALYSIS
C. C. Chamis, P. L. N. Murthy, S. N. Singhal, and J. J. Lackney (Sverdrup Technology, Inc., Brook Park, OH.) 1991 20 p Presented at the 36th International Gas Turbine and Aeroengine Congress and Exposition, Orlando, FL, 3-6 Jun. 1991; sponsored by ASME
(NASA-TM-103750; E-6002; NAS 1.15:103750) Avail: NTIS HC/MF A03 CSCL 20K

A computer code, high temperature composite analyzer (HITCAN), was developed to analyze/design hot metal matrix composite structures. HITCAN is a general purpose code for predicting the global structural and local stress-strain response of multilayered (arbitrarily oriented) metal matrix structures both at the constituent (fiber, matrix, and interphase) and the structural level, including the fabrication process effects. The thermo-mechanical properties of the constitutents are considered to be nonlinearly dependent on several parameters, including temperature, stress, and stress rate. The computational procedure employs an incremental iterative nonlinear approach utilizing a multifactor-interaction material behavior model, i.e., the material properties are expressed in terms of a product of several factors that affect the properties. HITCAN structural analysis capabilities (static, load stepping - a multistep static analysis with material properties updated at each step, modal, and buckling) for cooled hot structures are demonstrated through a specific example problem. Author

N91-21563# Wichita State Univ., KS. National Inst. for Aviation Research.
COMPARISON OF THE POST-BUCKLING BEHAVIOR OF METALLIC AND COMPOSITE PLATES WITH CENTRALLY LOCATED CU TOUTS M.S. Thesis
M. Rouhi and W. J. Horn May 1990 190 p
(PB91-118844; NIAR-90-14) Avail: NTIS HC/MF A09 CSCL 20K

An experimental investigation of the post-buckling characteristics of aluminum, graphite/epoxy, and graphite/PEEK square flat panels with centrally located circular holes is presented. The stability, post-buckling, ultimate strength, and energy absorption behavior of 0.08 inch thick aluminum panels were compared to that of composite plates with a stacking sequence of (-45/0/45/90/-45/45/-45/45)s for hole diameter to panel width ratios of 0, 0.2, 0.4, 0.5, and 0.7. A post-buckling, test fixture was designed and developed to examine compressive buckling, post-buckling, and failure mechanisms of the panels. Results indicate that both the metallic and composite panels have significant post-buckling strengths and load-carrying capabilities well beyond their initial buckling deformations. However, the presence of a circular cutout reduces the post-buckling strength of the plate but could actually increase the critical buckling load. GRA

N91-21564# Sandia National Labs., Albuquerque, NM.
UPDATE OF PRONTO 2D AND PRONTO 3D TRANSIENT SOLID DYNAMICS PROGRAM
S. W. Attaway Nov. 1990 42 p
(Contract DE-AC04-76DP-00789)
(DE91-009183; SAND-90-0102) Avail: NTIS HC/MF A03

PRONTO 2D and PRONTO 3D are 2-D and 3-D transient solid dynamics codes for analyzing large deformations of highly nonlinear materials subjected to high strain rates. Changes to these codes are documented. As of this writing, the latest version of PRONTO 2D is Version 4.5.6, and the latest version of PRONTO 3D is Version 4.5.6. This update of the two codes discusses two major modifications to the numerical formulations, three new constitutive models, and the additions and improvements of contact surfaces. Changes in file formats, other miscellaneous revisions, and the availability of PRONTO 2D and PRONTO 3D are also discussed. In addition, updated commands for PRONTO 2D are provided in Appendix A. DOE

N91-21565# Sandia National Labs., Albuquerque, NM.
DYNAMICS OF ROTATING FLEXIBLE STRUCTURES BY A METHOD OF QUADRATIC MODES
D. J. Segalman and C. R. Dohrmann Dec. 1990 27 p
(Contract DE-AC04-76DP-00789)
(DE91-009224; SAND-90-2737) Avail: NTIS HC/MF A03

The problem of calculating the vibrations of rotating structures has challenged analysts since the observation that use of traditional modal coordinates in such problems leads to the prediction of instability involving infinite deformation when rotation rates exceed the first natural frequency. Much recent published work on beams has shown that such predictions are artifacts of incorporating incomplete kinematics into the analysis, but that work addresses analysis of only simple structures such as individual beams and plates. A new approach is presented to analyze rotating flexible structures that applies to the rotation of general linear (unjointed) structures, using a system of nonlinearly coupled deformation modes. This technique is called a Method of Quadratic Modes. DOE

N91-21566# European Space Agency, Paris (France).
STRUCTURAL ANALYSIS AND OPTIMIZATION OF A PROPFAN BLADE BY USE OF THE FINITE ELEMENT METHOD
Rolf Lammering (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Goettingen, Germany, F.R.) Nov. 1990 69 p Transl. into ENGLISH of Strukturmechanische Berechnung und Optimierung eines Propfanblattes unter Verwendung der Finite-Element-Methode (Goettingen, Fed. Republic of Germany, DLR), 1990 55 p Original Language document was announced as N90-26006
(ESA-TT-1216; DLR-FB-90-01; ETN-91-98974) Avail: NTIS HC/MF A04; original German version available from DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 22.50 DM

The structural analysis of advanced propellers (propfans) is only possible if numerical methods are used because the geometry and loading make a geometrically nonlinear analysis necessary. Algorithms appropriate to the finite element method are presented and employed in the analysis of a propfan blade. This blade is discretized as a shallow shell. The constitutive equations for an isotropic material and for a composite material are implemented into the modeling of the finite elements. The quasistatic deformations resulting from the contrifugal force loading case and the natural modes and frequencies are presented (as a function of rotational speed). A propfan blade of composite material with six layers of equal thickness is considered and the methods of mathematical optimization are used to minimize the displacement at the tip of the blade, using fiber orientations as the design variables. In a second calculation, the twisting of the blade is minimized. It is shown that the deformation behavior can be influenced greatly by fiber orientation. ESA

N91-21567# Aeronautical Research Inst. of Sweden, Stockholm. Dept. of Structures.
CONTRIBUTIONS TO THE ANALYSIS OF THE DCB-SPECIMEN
Robin Olsson Nov. 1990 39 p Sponsored by Defence Material Administration, Stockholm, Sweden
(FFA-TN-1990-22; ETN-91-99041) Avail: NTIS HC/MF A03

A critical review of existing methods of analysis of the double

cantilever beam (DCB) specimen is presented. A simplified one dimensional analysis is proposed to incorporate the different effects that are neglected in simple cantilever beam analysis. The model is compared with more advanced one dimensional analyses. Crack length corrections are shown to improve the simple DCB formulae. Two dimensional plate analyses shows that the global stress state changes from pure plane strain to pure plane stress when the crack length to width ratio increases from zero to infinity. Thus, the strain energy release rate, G, computed from one dimensional analyses assuming either plane stress or plane strain will be affected. When loaded, the plate develops a saddle shaped curvature due to the Poisson effect. With increasing ratios, the transverse curvature approaches a constant value. Three dimensional analysis shows that DCB specimens with a straight crack front have a large variation in G over the specimen width. It is shown that this variation is due mainly to the transverse curvature. Because of the width variation of G, a growing crack will develop an increasing crack front curvature, as observed experimentally and predicted numerically. The influence of transverse curvature is shown to be small in unidirectional specimens, moderate in anisotropic and very large in plus or minus 45 specimens. ESA

N91-21568# Aeronautical Research Inst. of Sweden, Stockholm. Dept. of Structures.

STABILITY ANALYSIS OF A FUSELAGE SIDE

Rolf Jarlaas and Adam Zdunek Dec. 1990 42 p Sponsored by Defence Material Administration, Stockholm, Sweden
(FFA-TN-1990-32; ETN-91-99043) Avail: NTIS HC/MF A03

The structural response of a fuselage side of the civil aircraft SAAB 340A was investigated as a part of the certification program for the aircraft. The purpose was according to the test report to verify the stability of the fuselage frames and the window frames as well as the buckling behavior in the representing area. The structure was later analyzed with the finite element method. A comparison between experimental data and compared data showed unacceptably large discrepancies. The experimental situation as well as the finite element analysis are examined in an attempt to point the major causes for the discrepancies. Boundary conditions, discretization errors and modeling errors are discussed. No single effect was found which on its own explain the discrepancy between experimental and computed data. Significant discretization errors are shown to be present in the model used. It is also shown that the test-rig used in the experiments can not be considered as very stiff, making a non negligable contribution to the discrepancy. There are additional modeling errors such as neglection of thickness steps in the skin, and modeling of stringer fuselage intersections which were not considered in the present analyses. The p-version of the finite element method is introduced for the first time in the analysis of a real aircraft shell type structure. Results analyzed with both the linear and the newly developed nonlinear version of the program STRIPE are presented. ESA

N91-21569# Aeronautical Research Inst. of Sweden, Stockholm. Dept. of Structures.

APPLICATION OF THE p-VERSION FE METHOD TO GEOMETRICALLY NON-LINEAR PROBLEMS IN THREE DIMENSIONS

Adam Zdunek Dec. 1990 30 p Sponsored by Defence Material Administration, Stockholm, Sweden
(FFA-TN-1990-33; ETN-91-99044) Avail: NTIS HC/MF A03

The p version Finite Element (FE) methodology is applied to a class of kinematically nonlinear three dimensional so called small strain, large displacement elastostatic continuum problems. The STRIPE version FE system for the linear elastostatic problems is advantageously used as a platform for the development. The theoretical background of the total Lagrangean formulation chosen is given and discussed. Two simple elastical problems and a von Karman circular plate pressurization problem ressembling the so called blister test are used to verify the implementation. A more realistic example of an aircraft type panel, with over 40,000 unknowns, is used to demonstrate the usefulness of kinematically nonlinear three dimensional p version FE methodology. A simple continuation method with Newton equilibrium corrections is used to solve the linearized system of equations. In this introductory study the uniform extensions, typically 2 to 8, are always used at the first load step. In most cases this is not optimal. A future so called self adaptive p extension strategy should in the nonlinear case also be made adaptive with respect to the applied load level. That is, the iterative Newton continuation method and the ordinary adaptive p extension technique should be considered together. The main characteristics of the linear p version FE methodology seem to hold truth also for the kinematically nonlinear p version methodology. Using a series of p extensions in the kinematically nonlinear case, similar convergence characteristics as in the linear case were observed. Estimates of the converged FE solution therefore seem possible and consequently render the p version based FE solution reliable as in the linear case. ESA

N91-21570# Aeronautical Research Inst. of Sweden, Stockholm. Dept. of Structures.

MODE 1 INTERLAMINAR FRACTURE TOUGHNESS OF CARBON/PEEK PARTICIPATION IN AN INTERNATIONAL ROUND ROBIN PROGRAM

Robin Olsson 1990 44 p Sponsored by Defence Material Administration, Stockholm, Sweden
(FFA-TN-1990-41; ETN-91-99046) Avail: NTIS HC/MF A03

Participation in the European part of an international round robin test on interlaminar fracture toughness in mode 1 using the Double Cantilever Beam specimen (DCM) is described. The test was conducted by the European Group on Fracture (EGF), ASTM and the Japanese Institute of standards (JIS) and concentrated on initiation values in a carbon/PEEK composite. The specimen preparation and test procedure are described in detail. Three different evaluation methods were used. However, no significant difference was seen in results. Results are consistent with values reported by other groups and includes an initial 'hump' in a strain energy release rate G(sub IC) and a leveling off value of G(sub IC) = 1.6 kJ/sq m. Arguments are put forward against the use of initiation values as material properties. ESA

N91-21571# Polish Academy of Sciences, Warsaw. Dept. of Computational Engineering.

DETERMINISTIC AND STOCHASTIC SENSITIVITY IN COMPUTATIONAL STRUCTURAL MECHANICS

Duong Hien Tran Jun. 1990 177 p
(ISSN-0208-5658) Avail: NTIS HC/MF A09

A theory and computational methods for deterministic and stochastic sensitivity analysis of time-independent and time-varying system are provided. Discussions are restricted to multi-degrees of freedom linear-elastic 3D structures with fixed global configuration. On the basis of the displacement finite element modeling and a stochastic Hamiltonian's variational principle, two proposed new problems of computational mechanics are formulated for static and dynamic response sensitivity. A new form of response functionals is introduced in terms of a convolution of a time signal sequence enabling the dynamic sensitivity response to be dealt with at any particular instant. To eliminate the secularity appearing in the perturbation solutions, time-varying forcing functions are assembled into complex-valued series and the fast Fourier transform is employed to remove the resonant parts. To handle large finite element systems at acceptable computation cost, the two-fold superposition technique involving modal analysis and transformation from a correlated space to an uncorrelated space of random variables is presented. A complete algorithm was worked out and implemented into the microcomputer program POLSAP, a finite element code for deterministic and stochastic analysis of statics, minimum-weight optimization, buckling load, eigenpair, forced-vibration, eigen value sensitivity, static and dynamic response sensitivity of truss-beam-shell structures. A number of numerical results are presented. Author

N91-21572*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

CLOSED-FORM SOLUTIONS FOR LINEAR REGULATOR DESIGN OF MECHANICAL SYSTEMS INCLUDING OPTIMAL WEIGHTING MATRIX SELECTION

Brantley R. Hanks and Robert E. Skelton (Purdue Univ., West Lafayette, IN.) Mar. 1991 12 p Presented at the 32nd Structures, Structural Dynamics and Materials Conference, Baltimore, MD, 8-10 Apr. 1991
(NASA-TM-104052; NAS 1.15:104052) Avail: NTIS HC/MF A03 CSCL 20K

Vibration in modern structural and mechanical systems can be reduced in amplitude by increasing stiffness, redistributing stiffness and mass, and/or adding damping if design techniques are available to do so. Linear Quadratic Regulator (LQR) theory in modern multivariable control design, attacks the general dissipative elastic system design problem in a global formulation. The optimal design, however, allows electronic connections and phase relations which are not physically practical or possible in passive structural-mechanical devices. The restriction of LQR solutions (to the Algebraic Riccati Equation) to design spaces which can be implemented as passive structural members and/or dampers is addressed. A general closed-form solution to the optimal free-decay control problem is presented which is tailored for structural-mechanical system. The solution includes, as subsets, special cases such as the Rayleigh Dissipation Function and total energy. Weighting matrix selection is a constrained choice among several parameters to obtain desired physical relationships. The closed-form solution is also applicable to active control design for systems where perfect, collocated actuator-sensor pairs exist.
Author

N91-21573*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
PASSIVE DYNAMIC CONTROLLERS FOR NONLINEAR MECHANICAL SYSTEMS
Jer-Nan Juang, Shih-Chin Wu, Minh Phan, and Richard W. Longman (Columbia Univ., New York, NY.) Mar. 1991 16 p Presented at the 32nd Structures, Structural Dynamics and Materials Conference, Baltimore, MD, 8-10 Apr. 1991
(NASA-TM-104047; NAS 1.15:104047) Avail: NTIS HC/MF A03 CSCL 20K

A methodology for model-independant controller design for controlling large angular motion of multi-body dynamic systems is outlined. The controlled system may consist of rigid and flexible components that undergo large rigid body motion and small elastic deformations. Control forces/torques are applied to drive the system and at the same time suppress the vibration due to flexibility of the components. The proposed controller consists of passive second-order systems which may be designed with little knowledge of the system parameter, even if the controlled system is nonlinear. Under rather general assumptions, the passive design assures that the closed loop system has guaranteed stability properties. Unlike positive real controller design, stabilization can be accomplished without direct velocity feedback. In addition, the second-order passive design allows dynamic feedback controllers with considerable freedom to tune for desired system response, and to avoid actuator saturation. After developing the basic mathematical formulation of the design methodology, simulation results are presented to illustrate the proposed approach to a flexible six-degree-of-freedom manipulator. Author

N91-21574*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
COMPARISON OF SEVERAL SYSTEM IDENTIFICATION METHODS FOR FLEXIBLE STRUCTURES
J.-S. Lew (Old Dominion Univ., Norfolk, VA.), Jer-Nan Juang, and Richard W. Longman Mar. 1991 17 p Presented at the 32nd Structures, Structural Dynamics and Materials Conference, Baltimore, MD, 8-10 Apr. 1991
(NASA-TM-104046; NAS 1.15:104046) Avail: NTIS HC/MF A03 CSCL 20K

In the last few years various methods of identifying structural dynamics models from modal testing data have appeared. A comparison is presented of four of these algorithms: the Eigensystem Realization Algorithm (ERA), the modified version ERA/DC where DC indicated that it makes use of data correlation, the Q-Markov Cover algorithm, and an algorithm due to Moonen, DeMoor, Vandenberghe, and Vandewalle. The comparison is made using a five mode computer module of the 20 meter Mini-Mast truss structure at NASA Langley Research Center, and various noise levels are superimposed to produced simulated data. The results show that for the example considered ERA/DC generally gives the best results; that ERA/DC is always at least as good as ERA which is shown to be a special case of ERA/DC; that Q-Markov requires the use of significantly more data than ERA/DC to produce comparable results; and that is some situations Q-Markov cannot produce comparable results. Author

N91-21575*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
IDENTIFICATION OF LINEAR MULTIVARIABLE SYSTEMS FROM A SINGLE SET OF DATA BY IDENTIFICATION OF OBSERVERS WITH ASSIGNED REAL EIGENVALUES
Minh Phan, Jer-Nan Juang, and Richard W. Longman (Columbia Univ., New York, NY.) Mar. 1991 13 p Presented at the 32nd Structures, Structural Dynamics and Materials Conference, Baltimore, MD, 8-10 Apr. 1991
(NASA-TM-102669; NAS 1.15:102669) Avail: NTIS HC/MF A03 CSCL 20K

A formulation is presented for identification of linear multivariable from a single set of input-output data. The identification method is formulated with the mathematical framework of learning identifications, by extension of the repetition domain concept to include shifting time intervals. This method contrasts with existing learning approaches that require data from multiple experiments. In this method, the system input-output relationship is expressed in terms of an observer, which is made asymptotically stable by an embedded real eigenvalue assignment procedure. Through this relationship, the Markov parameters of the observer are identified. The Markov parameters of the actual system are recovered from those of the observer, and then used to obtain a state space model of the system by standard realization techniques. The basic mathematical formulation is derived, and numerical examples presented to illustrate. Author

N91-21576*# Old Dominion Univ., Norfolk, VA. Dept. of Mechanical Engineering and Mechanics.
GROUND-BASED TESTING OF THE DYNAMICS OF FLEXIBLE SPACE STRUCTURES USING BAND MECHANISMS Progress Report, period ending 15 Mar. 1991
L. F. Yang and Meng-Sang Chew May 1991 41 p
(Grants NAG1-1117; NAG1-830)
(NASA-CR-188154; NAS 1.26:188154) Avail: NTIS HC/MF A03 CSCL 20K

A suspension system based on a band mechanism is studied to provide the free-free conditions for ground based validation testing of flexible space structures. The band mechanism consists of a noncircular disk with a convex profile, preloaded by torsional springs at its center of rotation so that static equilibrium of the test structure is maintained at any vertical location; the gravitational force will be directly counteracted during dynamic testing of the space structure. This noncircular disk within the suspension system can be configured to remain unchanged for test articles with the different weights as long as the torsional spring is replaced to maintain the originally designed frequency ratio of W/k sub s. Simulations of test articles which are modeled as lumped parameter as well as continuous parameter systems, are also presented.
Author

N91-21577*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
A DISCOURSE ON SENSITIVITY ANALYSIS FOR DISCRETELY-MODELED STRUCTURES
Howard M. Adelman and Raphael T. Haftka (Virginia Polytechnic Inst. and State Univ., Blacksburg.) Mar. 1991 29 p
(NASA-TM-104065; NAS 1.15:104065) Avail: NTIS HC/MF A03 CSCL 20K

A descriptive review is presented of the most recent methods for performing sensitivity analysis of the structural behavior of discretely-modeled systems. The methods are generally but not

exclusively aimed at finite element modeled structures. Topics included are: selections of finite difference step sizes; special consideration for finite difference sensitivity of iteratively-solved response problems; first and second derivatives of static structural response; sensitivity of stresses; nonlinear static response sensitivity; eigenvalue and eigenvector sensitivities for both distinct and repeated eigenvalues; and sensitivity of transient response for both linear and nonlinear structural response. Author

N91-21578*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
ACTIVE VIBRATION ABSORBER FOR CSI EVOLUTIONARY MODEL: DESIGN AND EXPERIMENTAL RESULTS
Anne M. Bruner (Lockheed Engineering and Sciences Co., Hampton, VA.), W. Keith Belvin, Lucas G. Horta, and Jer-Nan Juang Mar. 1991 12 p Presented at the 32nd Structures, Structural Dynamics and Materials Conference, Baltimore, MD, 8-10 Apr. 1991
(NASA-TM-104048; NAS 1.15:104048) Avail: NTIS HC/MF A03 CSCL 20K

The development of control of large flexible structures technology must include practical demonstration to aid in the understanding and characterization of controlled structures in space. To support this effort, a testbed facility was developed to study practical implementation of new control technologies under realistic conditions. The design is discussed of a second order, acceleration feedback controller which acts as an active vibration absorber. This controller provides guaranteed stability margins for collocated sensor/actuator pairs in the absence of sensor/actuator dynamics and computational time delay. The primary performance objective considered is damping augmentation of the first nine structural modes. Comparison of experimental and predicted closed loop damping is presented, including test and simulation time histories for open and closed loop cases. Although the simulation and test results are not in full agreement, robustness of this design under model uncertainty is demonstrated. The basic advantage of this second order controller design is that the stability of the controller is model independent. Author

N91-21579*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
ON-ORBIT DAMAGE DETECTION AND HEALTH MONITORING OF LARGE SPACE TRUSSES: STATUS AND CRITICAL ISSUES
Thomas A. L. Kashangaki Mar. 1991 14 p Presented at the 32nd Structures, Structural Dynamics and Materials Conference, Baltimore, MD, 8-10 Apr. 1991
(NASA-TM-104045; NAS 1.15:104045) Avail: NTIS HC/MF A03 CSCL 20K

The long lifetimes, delicate nature and stringent pointing requirements of large space structures such as Space Station Freedom and geostationary Earth sciences platforms might require that these spacecraft be monitored periodically for possible damage to the load carrying structures. A review of the literature in damage detection and health monitoring of such structures is presented, along with a candidate structure to be used as a testbed for future work in this field. A unified notation and terminology is also proposed to facilitate comparisons between candidate methods. Author

N91-21580*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
STACKING-SEQUENCE OPTIMIZATION FOR BUCKLING OF LAMINATED PLATES BY INTEGER PROGRAMMING
Raphael T. Haftka (Virginia Polytechnic Inst. and State Univ., Blacksburg.) and Joanne L. Walsh Jan. 1991 10 p Presented at the 32nd Structures, Structural Dynamics and Materials Conference, Baltimore, MD, 8-10 Apr. 1991
(Grant NAG1-168)
(NASA-TM-104033; NAS 1.15:104033; AIAA-91-0970) Avail: NTIS HC/MF A02 CSCL 20K

Integer-programming formulations for the design of symmetric and balanced laminated plates under biaxial compression are presented. Both maximization of buckling load for a given total thickness and the minimization of total thickness subject to a buckling constraint are formulated. The design variables that define the stacking sequence of the laminate are zero-one integers. It is shown that the formulation results in a linear optimization problem that can be solved on readily available software. This is in contrast to the continuous case, where the design variables are the thicknesses of layers with specified ply orientations, and the optimization problem is nonlinear. Constraints on the stacking sequence such as a limit on the number of contiguous plies of the same orientation and limits on in-plane stiffnesses are easily accommodated. Examples are presented for graphite-epoxy plates under uniaxial and biaxial compression using a commercial software package based on the branch-and-bound algorithm. Author

N91-21581*# Analytical Mechanics Associates, Inc., Hampton, VA.
POWER OPTIMAL SINGLE-AXIS ARTICULATING STRATEGIES
Renjith R. Kumar and Michael L. Heck Feb. 1991 36 p
(Contract NAS1-18935)
(NASA-CR-187510; Rept-91-1; NAS 1.26:187510) Avail: NTIS HC/MF A03 CSCL 20K

Power optimal single axis articulating PV array motion for Space Station Freedom is investigated. The motivation is to eliminate one of the articular joints to reduce Station costs. Optimal (maximum power) Beta tracking is addressed for local vertical local horizontal (LVLH) and non-LVLH attitudes. Effects of intra-array shadowing are also presented. Maximum power availability while Beta tracking is compared to full sun tracking and optimal alpha tracking. The results are quantified in orbital and yearly minimum, maximum, and average values of power availability. Author

N91-21582# Argonne National Lab., IL.
DYNAMIC TUBE/SUPPORT INTERACTION IN HEAT EXCHANGER TUBES
S. S. Chen 1991 28 p Presented at the 5th International Conference on Flow Induced Vibrations, Brighton, England, 21-23 May 1991
(Contract W-31-109-eng-38)
(DE91-006089; CONF-910561-1) Avail: NTIS HC/MF A03

The supports for heat exchanger tubes are usually plates with drilled holes; other types of supports also have been used. To facilitate, manufacture and to allow for thermal expansion of the tubes, small clearances are used between tubes and tube supports. The dynamics of tube/support interaction in heat exchangers is fairly complicated. Understanding tube dynamics and its effects is important for heat exchangers. This paper summarizes the current state of the art on this subject and to identify future research needs. Specifically, the following topics are discussed: dynamics of loosely supported tubes, tube/support gap dynamics, tube response in flow, tube damage and wear, design considerations, and future research needs. DOE

N91-21583# Sandia National Labs., Albuquerque, NM.
EXPERIMENTAL LABORATORY SYSTEM TO GENERATE HIGH FREQUENCY TEST ENVIRONMENTS
D. L. Gregory and T. L. Paez 1991 5 p Presented at the 37th Annual Technical Meeting and Equipment Exposition of the Inst. of Environmental Sciences (IES), San Diego, 6-10 May 1991
(Contract DE-AC04-76DP-00789)
(DE91-008252; SAND-91-0400C; CONF-910531-2) Avail: NTIS HC/MF A01

This is an extension of two previous analytical studies to investigate a technique for generating high frequency, high amplitude vibration environments. These environments are created using a device attached to a common vibration exciter that permits multiple metal on metal impacts driving a test surface. These analytical studies predicted that test environments with an energy content exceeding 10 kHz could be achieved using sinusoidal and random shaker excitations. The analysis predicted that chaotic vibrations yielding random like test environments could be generated from sinusoidal inputs. In this study, a much simplified

version of the proposed system was fabricated and tested in the laboratory. Experimental measurements demonstrate that even this simplified system, utilizing a single impacting object, can generate environments on the test surface with significant frequency content in excess of 40 kHz. Results for sinusoidal shaker inputs tuned to create chaotic impact response are shown along with the responses due to random vibration shaker inputs. The experiments and results are discussed. DOE

N91-21584# Lawrence Livermore National Lab., CA.
PALM2D: A NONLINEAR FINITE ELEMENT PROGRAM FOR THE COUPLED THERMOMECHANICAL RESPONSE OF SOLIDS IN TWO DIMENSIONS
B. E. Engelmann, R. G. Whirley, and A. B. Shapiro 26 Mar. 1990 22 p
(Contract W-7405-eng-48)
(DE91-008423; UCID-21868) Avail: NTIS HC/MF A03

This manual describes the PALM2D analysis code. PALM2D solves for the coupled thermomechanical response of axisymmetric or plane strain solids, including nonlinear effects. This initial version of PALM2D borrows heavily from the LLNL codes TOPAZ2D for the solution of the thermal problem and NIKE2D for the solution of the mechanical problem. The thermal problem may include temperature dependent thermal conductivities and convection boundary conditions, and the mechanical problem may include large deformations and strains as well as material nonlinearities such as plasticity. Coupling is achieved through a staggered step formulation. Heat generation due to plastic work is included, and all heat transfer computations are done on the deformed geometry. PALM2D is a rapidly evolving code, and many enhancements are expected in the near future. DOE

N91-21585# Los Alamos National Lab., NM. Advanced Engineering Technology.
COMPUTER ANIMATION OF NASTRAN DISPLACEMENTS ON IRIS 4D-SERIES WORKSTATIONS: CANDI/ANIMATE POSTPROCESSING OF NASHUA RESULTS
Janine L. Fales 1991 12 p Presented at the 1991 NASTRAN Users Colloquium, Williamsburg, 22-26 Apr. 1991 Previously announced as N91-20514
(Contract W-7405-eng-36)
(DE91-008605; LA-UR-91-678; CONF-9104194-1) Avail: NTIS HC/MF A03

The capabilities of the postprocessing program CANDI (Color Animation of Nastran DIsplacements) have been expanded to accept results from axisymmetric analyses. An auxiliary program, ANIMATE, has been developed to allow color display of CANDI output on the IRIS 4D-series workstations. The user can interactively manipulate the graphics display by three-dimensional rotations, translations, and scaling through the use of the keyboard and/or dials box. The user can also specify what portion of the model is displayed. These developments are limited to the display of complex displacements calculated with the NASHUA/NASTRAN procedure for structural acoustics analyses. DOE

N91-21586# California Univ., Berkeley. Lawrence Berkeley Lab.
SUPERPLASTIC CREEP OF EUTECTIC TIN-LEAD SOLDER JOINTS
Z. Mei, R. Hansen, J. W. Morris, Jr., and M. C. Shine (Digital Equipment Corp., Cupertino, CA.) Sep. 1990 23 p Presented at the American Society of Mechanical Engineers (ASME) Winter Annual Meeting, Dallas, 25-30 Nov. 1990
(Contract DE-AC03-76SF-00098)
(DE91-009074; LBL-29614; CONF-901194-14) Avail: NTIS HC/MF A03

Creep behavior of air-cooled and liquid nitrogen-quenched soldered joints of 60/40 Sn-Pb at 65 C has been studied. The stress exponent, n, in the power law, gamma (steady state strain rate) proportional to sigma(sup n) (applied stress), changes from a value of about 6 to values of 2 or 3, as gamma decreases below 10(exp -4) in/in per second. This result, combined with the authors' previous stepped load creep test results, indicates a transition in creep deformation mechanism from conventional dislocation climbing to superplastic grain boundary sliding. The superplastic creep of the soldered joints is ascribed to their non-lamellar microstructure due to their fast cooling rate. During creep deformation, recrystallization of the soldered joints occurs, resulting in a softening phenomenon. DOE

N91-21587*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Facility, Edwards, CA.
STARS: AN INTEGRATED GENERAL-PURPOSE FINITE ELEMENT STRUCTURAL, AEROELASTIC, AND AEROSERVOELASTIC ANALYSIS COMPUTER PROGRAM
Kajal K. Gupta Jan. 1991 181 p Revised
(NASA-TM-101709-Rev; H-1582-Rev; NAS 1.15:101709-Rev)
Copyright Avail: NTIS HC/MF A09 CSCL 20K

The details of an integrated general-purpose finite element structural analysis computer program which is also capable of solving complex multidisciplinary problems is presented. Thus, the SOLIDS module of the program possesses an extensive finite element library suitable for modeling most practical problems and is capable of solving statics, vibration, buckling, and dynamic response problems of complex structures, including spinning ones. The aerodynamic module, AERO, enables computation of unsteady aerodynamic forces for both subsonic and supersonic flow for subsequent flutter and divergence analysis of the structure. The associated aeroservoelastic analysis module, ASE, effects aero-structural-control stability analysis yielding frequency responses as well as damping characteristics of the structure. The program is written in standard FORTRAN to run on a wide variety of computers. Extensive graphics, preprocessing, and postprocessing routines are also available pertaining to a number of terminals. Author

N91-21588# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
SINUSOIDAL RESPONSE OF A THIN VISCOPLASTIC PLATE WITH SEVERE TEMPERATURE GRADIENT M.S. Thesis
Kenneth J. Fischer Nov. 1990 67 p
(AD-A230938; AFIT/GAE/ENY/90D-06) Avail: NTIS HC/MF A04 CSCL 20/11

A mathematical model for the sinusoidal vibratory response of a thin plate subjected to a through the thickness temperature gradient is developed. An 85 percent copper/15 percent niobium composite plate was modeled using a temperature and frequency dependent model of the modulus. This modulus is based on a time dependent stress-strain constitutive relationship incorporating fractional calculus. Calculations were performed in the Laplace domain which facilitates straightforward manipulation of terms and equations. The resulting formulation accounts for the change in stiffness and damping characteristics through the thickness caused by viscoplastic effects due to the temperature gradient. GRA

N91-21589# Northwestern Univ., Evanston, IL. Dept. of Materials Science.
MATERIALS CAN BE STRESSED OUT TOO
I. C. Noyan and J. B. Cohen Dec. 1990 40 p
(Contract N00014-80-C-0116)
(AD-A231351) Avail: NTIS HC/MF A03 CSCL 11/6

Locked in or residual stresses occur almost always in making and using materials, from computer chips and dental fillings to tanker hulls, pipe lines and aircraft. These stresses can sometimes improve the life of a manufactured item, but can also lead to catastrophic failure. GRA

42 GEOSCIENCES (GENERAL)

N91-21590*# National Aeronautics and Space Administration, Washington, DC.
SOLID EARTH SCIENCE IN THE 1990S. VOLUME 2: PANEL REPORTS

Feb. 1991 281 p Presented at the Solid Earth Science Program Workshop, Coolfont, WV, 22-28 Jul. 1989
(NASA-TM-4256-Vol-2; NAS 1.15:4256-Vol-2) Avail: NTIS HC/MF A13 CSCL 08G

This is the second volume of a three-volume report. Volume 2, Panel Reports, outlines a plan for solid Earth science research for the next decade. The science panels addressed the following fields: plate motion and deformation, lithospheric structure and evolution, volcanology, Earth structure and dynamics, Earth rotation and reference frames, and geopotential fields. For individual titles, see N91-21591 through N91-21599.

N91-21591*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
REPORT OF THE PANEL ON PLATE MOTION AND DEFORMATION, SECTION 2 **c46**
Yehuda Bock, Kim A. Kastens, Marcia K. McNutt, J. Bernard Minster, Gilles Peltzer, William H. Prescott, Robert E. Reilinger, Leigh Royden, John B. Rundle (Sandia National Labs., Albuquerque, NM.), and Jeanne M. Sauber et al *In* National Aeronautics and Space Administration, Solid Earth Science in the 1990s. Volume 2: Panel Reports Feb. 1991 42 p (For primary document see N91-21590 13-42)
Avail: NTIS HC/MF A13 CSCL 08G

Given here is a panel report on the goals and objectives, requirements and recommendations for the investigation of plate motion and deformation. The goals are to refine our knowledge of plate motions, study regional and local deformation, and contribute to the solution of important societal problems. The requirements include basic space-positioning measurements, the use of global and regional data sets obtained with space-based techniques, topographic and geoid data to help characterize the internal processes that shape the planet, gravity data to study the density structure at depth and help determine the driving mechanisms for plate tectonics, and satellite images to map lithology, structure and morphology. The most important recommendation of the panel is for the implementation of a world-wide space-geodetic fiducial network to provide a systematic and uniform measure of global strain. Author

N91-21592*# Arizona Univ., Tucson.
REPORT OF THE PANEL ON LITHOSPHERIC STRUCTURE AND EVOLUTION, SECTION 3 **c46**
Clement G. Chase, Harold Lang, Marcia K. McNutt, Earnest D. Paylor, David T. Sandwell, and Robert J. Stern (Texas Univ., Dallas.) *In* National Aeronautics and Space Administration, Solid Earth Science in the 1990s. Volume 2: Panel Reports Feb. 1991 25 p (For primary document see N91-21590 13-42)
Avail: NTIS HC/MF A13 CSCL 08G

The panel concluded that NASA can contribute to developing a refined understanding of the compositional, structural, and thermal differences between continental and oceanic lithosphere through a vigorous program in solid Earth science with the following objectives: determine the most fundamental geophysical property of the planet; determine the global gravity field to an accuracy of a few milliGals at wavelengths of 100 km or less; determine the global lithospheric magnetic field to a few nanoTeslas at a wavelength of 100 km; determine how the lithosphere has evolved to its present state via acquiring geologic remote sensing data over all the continents. Author

N91-21593*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
REPORT OF THE PANEL ON VOLCANOLOGY, SECTION 4 **c46**
Peter W. Francis, Peter Mouginis-Mark, David C. Pieri, William Rose, Stephen Self, and Charles A. Wood (National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.) *In* National Aeronautics and Space Administration, Solid Earth Science in the 1990s. Volume 2: Panel Reports Feb. 1991 23 p (For primary document see N91-21590 13-42)
Avail: NTIS HC/MF A13 CSCL 08G

Two primary goals are identified as focal to NASA's research efforts in volcanology during the 1990s: to understand the eruption of lavas, gases, and aerosols from volcanoes, the dispersal of these materials on the Earth's surface and through the atmosphere, and the effects of these eruptions on the climate and environment; and to understand the physical processes that lead to the initiation of volcanic activity, that influence the styles of volcanic eruptions, and that dictate the morphology and evolution of volcanic landforms. Strategy and data requirements as well as research efforts are discussed. Author

N91-21594*# Washington Univ., Seattle.
REPORT OF THE PANEL ON THE LAND SURFACE: PROCESS OF CHANGE, SECTION 5 **c46**
John B. Adams, Eric E. Barron, Arthur A. Bloom, Carol Breed, J. Dohrenwend, Diane L. Evans, Thomas T. Farr, Allan R. Gillespie, B. L. Isaks, and Richard S. Williams (Geological Survey, Reston, VA.) *In* National Aeronautics and Space Administration, Solid Earth Science in the 1990s. Volume 2: Panel Reports Feb. 1991 27 p (For primary document see N91-21590 13-42)
Avail: NTIS HC/MF A13 CSCL 08G

The panel defined three main areas of study that are central to the Solid Earth Science (SES) program: climate interactions with the Earth's surface, tectonism as it affects the Earth's surface and climate, and human activities that modify the Earth's surface. Four foci of research are envisioned: process studies with an emphasis on modern processes in transitional areas; integrated studies with an emphasis on long term continental climate change; climate-tectonic interactions; and studies of human activities that modify the Earth's surface, with an emphasis on soil degradation. The panel concluded that there is a clear requirement for global coverage by high resolution stereoscopic images and a pressing need for global topographic data in support of studies of the land surface. Author

N91-21595*# Harvard Univ., Cambridge, MA.
REPORT OF THE PANEL ON EARTH STRUCTURE AND DYNAMICS, SECTION 6 **c46**
Adam M. Dziewonski, David C. McAdoo, Richard J. OConnell, Douglas E. Smylie, and Charles F. Yoder (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) *In* National Aeronautics and Space Administration, Solid Earth Science in the 1990s. Volume 2: Panel Reports Feb. 1991 26 p (For primary document see N91-21590 13-42)
Avail: NTIS HC/MF A13 CSCL 08G

The panel identified problems related to the dynamics of the core and mantle that should be addressed by NASA programs. They include investigating the geodynamo based on observations of the Earth's magnetic field, determining the rheology of the mantle from geodetic observations of post-glacial vertical motions and changes in the gravity field, and determining the coupling between plate motions and mantle flow from geodetic observations of plate deformation. Also emphasized is the importance of support for interdisciplinary research to combine various data sets with models which couple rheology, structure and dynamics. Author

N91-21596*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
REPORT OF THE PANEL ON EARTH ROTATION AND REFERENCE FRAMES, SECTION 7 **c46**
Jean O. Dickey, Steven R. Dickman, Marshall T. Eubanks, Martine Feissel, Thomas A. Herring, Ivan I. Mueller, Richard D. Rosen, Robert E. Schutz, John M. Wahr, and Charles R. Wilson (Texas Univ., Austin.) *In* National Aeronautics and Space Administration, Solid Earth Science in the 1990s. Volume 2: Panel Reports Feb. 1991 22 p (For primary document see N91-21590 13-42)
Avail: NTIS HC/MF A13 CSCL 08G

Objectives and requirements for Earth rotation and reference frame studies in the 1990s are discussed. The objectives are to observe and understand interactions of air and water with the rotational dynamics of the Earth, the effects of the Earth's crust and mantle on the dynamics and excitation of Earth rotation variations over time scales of hours to centuries, and the effects of the Earth's core on the rotational dynamics and the excitation

of Earth rotation variations over time scales of a year or longer. Another objective is to establish, refine and maintain terrestrial and celestrial reference frames. Requirements include improvements in observations and analysis, improvements in celestial and terrestrial reference frames and reference frame connections, and improved observations of crustal motion and mass redistribution on the Earth. Author

N91-21597*# National Aeronautics and Space Administration, Washington, DC.
REPORT OF THE PANEL ON GEOPOTENTIAL FIELDS: GRAVITY FIELD, SECTION 8 **c46**
Allen Joel Anderson, William M. Kaula, Andrew R. Lazarewics, Michel Lefebvre, Roger J. Phillips, Richard H. Rapp, Reinhard F. Rummel, David E. Smith, Byron D. Tapley, and Victor Zlotnick (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) *In its* Solid Earth Science in the 1990s. Volume 2: Panel Reports Feb. 1991 20 p (For primary document see N91-21590 13-42)
Avail: NTIS HC/MF A13 CSCL 08G

The objective of the Geopotential Panel was to develop a program of data acquisition and model development for the Earth's gravity and magnetic fields that meet the basic science requirements of the solid Earth and ocean studies. Presented here are the requirements for gravity information and models through the end of the century, the present status of our knowledge, data acquisition techniques, and an outline of a program to meet the requirements. Author

N91-21598*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
REPORT OF THE PANEL ON GEOPOTENTIAL FIELDS: MAGNETIC FIELD, SECTION 9 **c46**
Jose J. Achache, George E. Backus, Edward R. Benton, Christopher G. A. Harrison (Miami Univ., Coral Gables, FL.), and Robert A. Langel *In* National Aeronautics and Space Administration, Solid Earth Science in the 1990s. Volume 2: Panel Reports Feb. 1991 35 p (For primary document see N91-21590 13-42)
Avail: NTIS HC/MF A13 CSCL 08G

The objective of the NASA Geodynamics program for magnetic field measurements is to study the physical state, processes and evolution of the Earth and its environment via interpretation of measurements of the near Earth magnetic field in conjunction with other geophysical data. The fields measured derive from sources in the core, the lithosphere, the ionosphere, and the magnetosphere. Panel recommendations include initiation of multi-decade long continuous scalar and vector measurements of the Earth's magnetic field by launching a five year satellite mission to measure the field to about 1 nT accuracy, improvement of our resolution of the lithographic component of the field by developing a low altitude satellite mission, and support of theoretical studies and continuing analysis of data to better understand the source physics and improve the modeling capabilities for different source regions. Author

N91-21599*# National Aeronautics and Space Administration, Washington, DC.
REPORT OF THE PANEL ON INTERNATIONAL PROGRAMS
Allen Joel Anderson, Karl W. Fuchs, Yasuhiro Ganeka, Vinod Gaur, Andrew A. Green, W. Siegfried, Anthony Lambert, Jacub Rais, Christopher Reighber, and Herman Seeger (Institut fuer Angewandte Geodaesie, Frankfurt am Main, Germany, F.R.) et al *In its* Solid Earth Science in the 1990s. Volume 2: Panel Reports Feb. 1991 47 p (For primary document see N91-21590 13-42)
Avail: NTIS HC/MF A13 CSCL 08G

The panel recommends that NASA participate and take an active role in the continuous monitoring of existing regional networks, the realization of high resolution geopotential and topographic missions, the establishment of interconnection of the reference frames as defined by different space techniques, the development and implementation of automation for all ground-to-space observing systems, calibration and validation experiments for measuring techniques and data, the establishment of international space-based networks for real-time transmission of high density space data in standardized formats, tracking and support for non-NASA missions, and the extension of state-of-the art observing and analysis techniques to developing nations. Author

43 EARTH RESOURCES AND REMOTE SENSING

Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography.

For instrumentation see *35 Instrumentation and Photography.*

N91-21600# United States Man and the Biosphere Program, Washington, DC.
BIBLIOGRAPHY ON THE INTERNATIONAL NETWORK OF BIOSPHERE RESERVES
Jul. 1990 56 p
(PB90-215518; PUB-9799) Avail: NTIS HC/MF A04 CSCL 08E

Since the first biosphere reserves were designated in 1976 as part of UNESCO's Man and the Biosphere Program, they have continued to demonstrate the value of conservation in sustaining society. A considerable body of literature was produced concerning the concept of biosphere reserves and its implication through research and special programs. The bibliography references that literature. Most often, MAB committees and associated organizations are the principal sources of the cited literature. A list of addresses for these principal sources is provided at the end of the bibliography. The bracketed code letters following each entry correspond to a principal known or most likely source on the list. Copies of individual publications may be obtained from these addresses, usually at no cost. GRA

N91-21601# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany, F.R.). Abt. Fernerkungdungsanwendungen.
REGISTRATION OF WINDFALL DAMAGE IN THE EASTERN HUNSRUECK PLATEAU (FED. REPUBLIC OF GERMANY) UTILIZING LANDSAT TM DATA: A LANDSCAPE-ECOLOGICAL ANALYSIS FOR PRACTICAL FORESTRY Thesis - Bonn Univ.
Johannes Wieczorek Jun. 1990 149 p In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-1253) Original contains color illustrations
(DLR-FB-90-31; ISSN-0171-1342; ETN-91-99030) Avail: NTIS HC/MF A07; DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 53 DM

A mapping of windfall areas in the region of the Hunsrueck plateau is achieved. Data from the LANDSAT Thematic Mapper were used as well as a Geographical Information System (GIS). By classification of the given data, the spruce (Picea abies) grown in monocultures was identified as the species most heavily affected by windfall. By correlating these results with digital soil data, the static wet soils can be identified as those which show the highest potential for windfall damage, in combination with the flat rooting spruce. ESA

N91-21602# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
EVALUATION OF TM/LANDSAT-5 BANDS IN THE DISCRIMINATION OF WHEAT AND BEAM CROPS
Jose Carlos NevesEpiphanio, Antonio Roberto Formaggio, and Geraldo VictorinodeFranca (Sao Paulo Univ., Brazil) Nov. 1990 20 p In PORTUGUESE; ENGLISH summary Submitted for publication
(INPE-5204-PRE/1666) Avail: NTIS HC/MF A03

The objective was to assess the potential of the six reflective TM/LANDSAT-5 bands for discriminating between wheat and bean fields. Fifteen fields of both crops of wheat and bean were selected

at the Sao Paulo State, Brazil region for which three multidate cloud free TM sets were acquired during the winter growing season of 1986. Digital numbers were sampled for the 30 fields and corrected for additive effects before being transformed into reflectance values. These values were used for calculating the EAC index which expresses the potential of each TM band for spectral discrimination between wheat and bean fields. It was shown that the TM7 was the best band; TM2, TM3, and TM5 were intermediaries; and in the last position were TM1 and TM4 bands. It was shown that the vegetative phase was more appropriate than the reproductive phase of the biological cycle as far as wheat and bean discrimination is concerned. The comparison between simulated reflectance data agreed very well except for the TM7 band. A need for more detailed investigation about the reflective properties and the discrimination potential of the TM7 spectral band was aroused. Author

N91-21603# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
REMOTE SENSING ESTIMATION OF TOTAL CHLOROPHYLL PIGMENT DISTRIBUTION IN BARRA BONITA RESERVOIR
Evlyn Marcia LeaodeMoraesNovo, Claudia Zuccari Fern Braga, and Jose Galisia Tundisi (Sao Paulo Univ., Brazil) Nov. 1990 15 p Submitted for publication
(INPE-5202-PRE/1664) Avail: NTIS HC/MF A03

Preliminary results of a research project carried out at the Barra Bonita Reservoir to assess how the current remote sensing technology can provide useful information for limnological studies are discussed. Water samples collected during the LANDSAT 5 overpass were used to calibrate Thematic Mapper data and to generate an empirical model for estimating the total surface chlorophyll pigment distribution in the reservoir. Author

N91-21604# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
TM/LANDSAT-5 MULTISPECTRAL REFLECTANCE FOR THE REMOTE SENSING OF THE CONDITION OF BEAN CROP VIGOR [REFLECTANCIA MULTIESPECTRAL TM/LANDSAT-5 PARA O SENSORIAMENTO REMOTO DAS CONDICOES DE VIGOR DA CULTURA DE FEIJAO]
Antonio Roberto Formaggio and Jose Carlos Neves Epiphanio Nov. 1990 10 p In PORTUGUESE; ENGLISH summary Presented at the 6th Brazilian Symposium on Remote Sensing, Manaus, Brazil, 24-29 Jun. 1990
(INPE-5184-PRE/1652) Avail: NTIS HC/MF A02

The objectives were to give some subsidy and basis to the understanding of the relationships between multispectral (six TM reflective bands, Simple Ratio and Normalized Difference) and agronomic variables, for beans. Data were obtained in commercially irrigated fields at the northeastern Sao Paulo State during 1986 and 1987 winter cycles. Leaf Area Index, Phytomass and Percent Soil Cover are excellent descriptors of bean vigor; TM3, TM4, TM5, Simple Ratio, and Normalized Difference correlated well (mainly during presenescence) with those agronomic variables. Yield variables (RE and RD) didn't correlate directly both with agronomic and spectral parameters. Author

N91-21605# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
EXPERIENCES IN ASSESSING CHANGES IN THE USE OF SAVANNA ECOSYSTEMS
Joao RobertodosSantos Nov. 1990 12 p Presented at the Recent Approaches and Methods for the Sustainable Use of Land in Latin America, Santiago, Chile, 23 Jul. 1990; sponsored by SCOPE
(INPE-5187-PRE/1655) Avail: NTIS HC/MF A03

Some experiences on the application of remote sensing data (MSS or TM/LANDSAT, HRV/SPOT, and AVHRR/NOAA) as a tool in assessing changes in the use of Brazilian savannas is presented. The adopted approach exposes the use of orbital data in order to understand the geographical distribution of the savannas, to estimate vegetation biomass, to identify and evaluate burned areas, and to monitor agricultural and reforestation activities in the savanna region. Author

N91-21606# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil). Departamento de Pesquisa e Aplicacoes.
VERIFICATION OF PARAMETERS AND MORPHOLOGICAL-ENVIRONMENTAL PROPERTIES, BY SATELLITE IMAGERY, FOR STUDIES OF COASTAL REGION PLANNING [VERIFICACAO DE PARAMETROS E PROPRIEDADES MORFOAMBIENTAIS, EM IMAGENS DE SATELITE, PARA ESTUDOS DO PLANEJAMENTO DE AREAS LITORANEAS]
Juercio Tavares deMattos and Ricardo Vedovello Nov. 1990 7 p In PORTUGUESE; ENGLISH summary Presented at the 6th Brazilian Symposium on Remote Sensing, Manaus, Brazil, 24-29 Jun. 1990
(INPE-5177-PRE/1646) Avail: NTIS HC/MF A02

A comparison is made of structural and textural elements of orbital images (Thematic Mapper - LANDSAT and SPOT) for geotechnical mapping purposes. The objective is to obtain a subsidy for integrated survey focusing on the economic development and environmental control of coastal regions. Author

N91-21607# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
TEMPORAL VARIATION OF AREAS OCCUPIED BY AQUATIC MACROPHYTES IN THE TUCURUI RESERVOIR THROUGH LANDSAT/TM DATA
Myrian deMouraAbdon and Marion Meyer Nov. 1990 6 p In PORTUGUESE; ENGLISH summary Presented at the 6th Brazilian Symposium on Remote Sensing, Manaus, 24-29 Jun. 1990
(INPE-5174-PRE/1643) Avail: NTIS HC/MF A02

LANDSAT/TM data were used to identify the occurrence of aquatic macrophytes within the Tucurui reservoir, Para State, Brazil. Images of the dry period were used in the consecutive years from 1986-1987. The classification of the macrophyte areas was done by slicing vegetative index imagery derived from applying the normalized ratio between LANDSAT/TM bands 3 and 4. Those classes were used as training sites to implement a maximum likelihood classification on the remaining study area. The results were plotted in maps using the scale of 1:250,000. Author

N91-21608# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
SPOT 1: IMAGERY IN GEOLOGIC MAPPING: A COMPARATIVE STUDY WITH SEVERAL REMOTE SENSING PRODUCTS IN THE CURACA RIVER VALLEY, BAHIA
Waldir RenatoParadella, Icaro Vitorello, Liu Chan Chiang, Juercio TavaresdeMattos, Luciano VieiraDutra, and Paulo Roberto Meneses (Brasilia Univ., Brazil) Sep. 1990 50 p In PORTUGUESE; ENGLISH summary Submitted for publication
(INPE-5136-PRE/1624) Avail: NTIS HC/MF A03

The advent of new remote sensing products from TM-Landsat and SPOT with geologically interesting technical characteristics but higher acquisition prices compared to the MSS, brought up the need of performance evaluation in the Brazilian territory. The goal is to qualitatively compare the spatial and spectral performances of multispectral and panchromatic SPOT under oblique viewing with TM and MSS-Landsat and air photos in the context of structural and lithological mapping. The test area with neary 900 sq km is located in the lower Curaca River Valley, Northeast of Brazil (Bahia State) and is characterized by precambrian terrains in a semiarid environment. Photographic paper products were submitted to visual analysis to appropriate scales for regional and local mapping, and digital data were subjected to enhancement and merging processing. Additionally, digital data were normalized into radiometric values with the purpose of detecting oblique viewing effects. Radiometeric values from west pointing Spot and nadir TM from the same sites have shown differences that can be attributed to the greater atmospheric interference in the SPOT viewing configuration. Such difference is greatest at the shorter wavelengths and decreases towards the near infrared, but without serious degradation in the context of

the present study. At the regional scale, neither SPOT nor TM-Landsat, in photographic paper products, have added significant geological information to the previous map based on computer processed MSS-Landsat data. However, computer merged products have shown that lithological discrimination can be enhanced by the combination of the high spatial resolution SPOT panchromatic image with the geologically important infrared TM bands. Similarly, the stereo vision provided by the SPOT pairs can be combined with processed TM products to optimize interpretation at local scales. Whereas the latter requires expensive digital processing, the stereoscopic vision needs a pair of opposing oblique viewing obtained under clear atmospheric conditions and a special schedule in the satellite coverage, which represents additional difficulties in the acquisition of SPOT stereo data. Author

N91-21609# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

USE OF DIRECT EXPANSION FOR ESTIMATION OF SOYBEAN AND CORN AREAS THROUGH MULTISPECTRAL AND TEMPORAL LANDSAT/TM DATA [USO DA EXPANSAO DIRETA PARA ESTIMAR AREAS DE SOJA E MILHO ATRAVES DE DADOS MULTIESPECTRAIS E TEMPORAIS DO LANDSAT/TM]

Mauricio AlvesMoreira Nov. 1990 12 p In PORTUGUESE; ENGLISH summary Presented at the 6th Brazilian Symposium on Remote Sensing, Manaus, Brazil, 24-29 Jun. 1990

(INPE-5180-PRE/1649) Avail: NTIS HC/MF A03

The contribution of LANDSAT/TM data in estimating soybean and corn areas was analyzed through a direct expansion method by sampling techniques. The study was carried out in the test site of Distrito Federal (5,814 sq km), covered by LANDSAT/TM (row/path 221/71) data. The color composition, bands 3, 4, and 5 in the scale of 1:100,000) dated Jan. 2, 1989 and Jun. 4, 1989, were utilized using visual interpretation. The methodology employed consisted in identifying and mapping soybean and corn areas inside 135 sampling units, stratified according to land use criterion. Soybean and corn areas were estimated using the statistical direct expansion method. It was concluded that: (1) the performance obtained in this study was as good as the one obtained through IBGE methodology; (2) in crop years where the period of planting is expanded, the multitemporal criterion is essential to obtain better performance in the area estimation. Author

N91-21610# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

VOLCANIC-SEDIMENTARY SEQUENCE OF THE GREENSTONE BELT TYPE IN THE SANTA RITA OR GOIAS ELEVATION: AN APPROACH WITH TM-LANDSAT DATA

Celio EustaquiodosAnjos and Athos RibeirodosSantos Nov. 1990 8 p In PORTUGUESE; ENGLISH summary Presented at the 6th Brazilian Symposium on Remote Sensing, Manaus, 24-29 Jun. 1990

(INPE-5178-PRE/1647) Avail: NTIS HC/MF A02

The Goiano Complex is the oldest unit and composed largely of granitoids, gneiss, and migmatites in the amphiblite facies. A volcanic-sedimentary sequence was deposited over the already formed sialic crust and is denominated the Pilar de Goias Group which characterizes the Greenstone Belts in the region. The Goias Greenstone Belt, in the Santa Rita Region, is included in these sequences and was subdivided into three photogeological units by using TM-LANDSAT imagery. The contact relations indicate tectonic limits by thrust faults NW, NNW, normal faults NNW-NW, NE-NNE, and fracture systems that were interpreted at 1:100,000. Preliminary analysis shows the distribution of the sequences and structural pictures and indicates that remote sensing can be used as a mineral prospection tool on a regional scale. Author

N91-21611# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

COMPARATIVE ANALYSIS OF AVHRR/NOAA AND TM/LANDSAT DATA IN THE DELIMITATION OF SAVANNA/FOREST CONTACT AREA: PRELIMINARY RESULTS [ANALISE COMPARATIVA DOS DADOS AVHRR/NOAA E TM/LANDSAT NA DELIMITACAO DO CONTATO SAVANA/FLORESTA: RESULTADOS PRELIMINARES]

Joao RobertodosSantos, Yosio Edemir Shimabukuro, and David Chung Liang Lee Nov. 1990 17 p In PORTUGUESE; ENGLISH summary Original contains color illustrations

(INPE-5200-RPE/639) Avail: NTIS HC/MF A03

The relationship between advanced very high resolution radiometer (AVHRR)/NOAA and thematic mapper (TM)/LANDSAT data is evaluated for estimating the contact area of the savanna and forest. This study is a contribution to the development of a multisensor approach to study the characteristics of the vegetation and the anthropic activities in Brazil. The study area includes parts of the following states: Amazonas, Mato Grosso, and Rondonia. The classified AVHRR imagery (UNEP-GRID Project) were evaluated by comparing these results to the TM imagery, using a universal transverse Mercator (UTM) projection grid as a reference. A regression analysis with linear function was applied to evaluate the relationship between TM and AVHRR of the estimated area. The results indicate that the AVHRR and TM variables present a highly significant correlation ($r = 0.9874$) and that the independent variable (AVHRR) can explain about 97.5 percent of variations found in the estimated area with a standard deviation of 6 percent. After analyzing the residuals of the regression, it was found that there is no significant difference between AVHRR and TM sensor data in the spatial distribution of the savanna. The preliminary results obtained in this research, outline the importance of multisensor approach to monitor the space-temporal dynamics of the vegetation of Brazil. Author

N91-21612# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

INTRODUCTION TO DIGITAL IMAGERY PROCESSING [INTRODUCAO AO PROCESSAMENTO DIGITAL DE IMAGENS]

Nelson Delfino dAvilaMascarenhas Dec. 1990 36 p In PORTUGUESE; ENGLISH summary

(INPE-5212-MD/46) Avail: NTIS HC/MF A03

The following techniques, which are used in digital image processing, are briefly presented: (1) sampling and quantization, (2) enhancement, (3) restoration, (4) reconstruction, (5) coding, (6) image analysis, and (7) image classification Author

N91-21613# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

DISCRIMINATION OF LITHOLOGICAL UNITS IN THE LOWER VALLEY OF THE CURACA RIVER (BAHIA), THROUGH ENHANCEMENT OF DIGITAL PROCESSING OF MSS-LANDSAT-3 DATA Thesis - Sao Paulo Univ., 1983 [DISCRIMINACAO DE UNIDADES LITOLOGICAS NO NO BAIXO VALE DO RIO CURACA (BAHIA), ATRAVES DE REALCES POR PROCESSAMENTO DIGITAL DE DADOS MSS-LANDSAT 3]

Waldir Renato Paradella Sep. 1990 272 p In PORTUGUESE; ENGLISH summary

(INPE-5120-RPE/627) Avail: NTIS HC/MF A12

Spectral and multitemporal informations detected by computer enhanced LANDSAT-MSS 3 were evaluated within the context of lithological discrimination in a semi-arid tropical region of the northeast of Brazil. The techniques used, including (1) linear contrast stretch, (2) contrast stretched color composites, (3) band-ratioing, and (4) Principal Components, make it possible to emphasize subtle differences in the spectral reflectance of the surface, good indicators of geobotanical controls given by variations in the vegetation cover and the changes in the residual soil compositions well correlated to the lithological variations of the substratum. The observed brightness and total patterns correspond exceptionally well to the lithological units mapped by conventional

geological methods in the 1:50,000 scale and provided, additionally, new contributions to the geological understanding of the area.
Author

N91-21614# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
SPECTRAL RESPONSES OF SOYBEAN AND COTTON FROM LANDSAT/TM DIGITAL DATA [RESPOSTAS ESPECTRAIS DE SOJA E ALGODAO A PARTIR DE DADOS DIGITAIS DE TM-LANDSAT]
Sherry Chou Chen Nov. 1990 10 p In PORTUGUESE; ENGLISH summary Presented at the 6th Brazilian Symposium on Remote Sensing, Manaus, Brazil, 24-29 Jun. 1990
(INPE-5179-PRE/1648) Avail: NTIS HC/MF A02

A study was carried out to characterize the spectral responses of soybeans and cotton using Landsat-TM digital data. This spectral information is essential for crop identification using remote sensing data to provide agricultural statistics in a reasonable lead time. Study result show that there are relative differences in spectral response among soybeans, cotton, pasture, and natural forest. These spectral differences can be included together with textural and contextural parameters in an expert system for crop classification.
Official Gazette of the U.S. Patent and Trademark Office

N91-21615# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
PRODUCTION OF IMAGE PROPORTIONS THROUGH A LINEAR MIXING MODEL [GERACAO DE IMAGENS DE PROPORCOES ATRAVES DE UM MODELO LINEAR DE MISTURA]
Adriana Abrahao, Eliana Miglioranza, and Moacir GodoyJunior Nov. 1990 8 p In PORTUGUESE; ENGLISH summary Presented at the 6th Brazilian Symposium on Remote Sensing, Manaus, Brazil, 24-29 Jun. 1990
(INPE-5170-PRE/1639) Avail: NTIS HC/MF A02

The steps for implementing and operating a linear mixing model are defined using the principal components analysis. Using a LANDSAT-TM image, converted to apparent reflectance, up to six synthetic new bands are produced. Each new band represents the proportion of a given component which was part of the original imagery. Input data for implementing the model can be both; samples from the original image, corresponding to endmembers, and radiometric information collected on the ground. Additional studies are being carried out to verify how good the adjustment was between target reflectance and its respective digital value.
Author

N91-21616# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
DATA INTEGRATION OF DIFFERENT SENSOR SYSTEMS THROUGH THE TECHNIQUE OF IHS TRANSFORMATION, THE PURPOSE AND STUDY OF INTRA-URBAN STRUCTURE [INTEGRACAO DE DADOS DE DIFERENTES SISTEMAS SENSORES ATRAVES DA TECNICA DE TRANSFORMACAO IHS, VISANDO O ESTUDO DA ESTRUTURA INTRA-URBANA]
Maria deLourdesNevesdeOliveiraKurkdjian Nov. 1990 7 p In PORTUGUESE; ENGLISH summary Presented at the 6th Brazilian Symposium on Remote Sensing, Manaus, Brazil, 24-29 Jun. 1990
(INPE-5171-PRE/1640) Avail: NTIS HC/MF A02

To study the intraurban structure using remote sensing data, both high spectral and spatial resolutions are needed. The color space transformations (IHS transformations) were used to integrate TM (Thematic Mappers) 4, 3, 2 data with SPOT-PAN data; SPOT-XS data with SPOT-PAN data; SPOT-XS data with an aerial photography. The purpose was to prepare hybrid images with the spatial resolution of one of the other components and the spectral resolution of the other. The products resulted from these integrations showed the utility of the IHS transformations to integrate different sensor's products, and the quality of these new products for the purpose of the intraurban land use analysis.
Author

N91-21617# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
A DIGITAL DATA BANK FOR GEOLOGICAL EXPLORATION IN THE MINING BELT OF THE POJUCA (CARAJAS) Cu-Zn DEPOSIT, BASED ON GEOLOGICAL, GEOCHEMICAL, REMOTE SENSING, AND ELEVATION DATA [UM BANCO DE DADOS DIGITAIS PARA EXPLORACAO GEOLOGICA NA FAIXA MINERALIZADA EM CU-ZN DO POJUCA (CARAJAS), BASEADO EM DADOS GEOLOGICOS, GEOQUIMICOS, DE SENSORES REMOTOS E DE ELEVACAO]
Waldir Reuato Paradella, C. A. Kushigbor, and A. G. Fabbri (Canada Centre for Remote Sensing, Ottawa, Ontario) Nov. 1990 16 p In PORTUGUESE; ENGLISH summary Presented at the 6th Brazilian Symposium on Remote Sensing, Manaus, Brazil, 24-29 Jun. 1990
(INPE-5172-PRE/1641) Avail: NTIS HC/MF A03

Several aspects of the development of a digital geological data base for regional and detailed exploration in the Pojuca area, Carajas Province, are discussed. A 230 sq km test site was selected centered in the Pojuca Cu-Zn deposit. UTM-registered multiple data sets were constructed which include TM-LANDSAT images, a DEM represented by images of Elevation, Slope, and Aspect, digitized geology and ten planes representing geochemical data from soil samples (Al, Fe, Mg, Mn, Ti, Co, Ni, V, Cu, and Zn). The multiple data set will be used for many studies at distinct resolutions, to compare digital processing methods in RS and to extract possible relationships between the different images that can be relevant in terms of geological knowledge, mineral resources, and environmental analysis.
Author

N91-21618# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
CORRELATIVE STUDIES BETWEEN SPECTRAL RESPONSES AND WEATHERING INDICES OF ALTERNATE WEATHERED COVER [ESTUDOS CORRELATIVOS ENTRE RESPOSTAS ESPECTRAIS E INDICES DE INTEMPERISMO DE COBERTURAS DE ALTERACAO INTEMPERICAS]
Jairo Roberto JimenezRueda, Juercio Tavares deMattos, and P. S. Riedel (Universidade Estadual de Paulista, Rio Claro, Brazil) Nov. 1990 16 p In PORTUGUESE; ENGLISH summary Presented at the 6th Brazilian Symposium on Remote Sensing, Manaus, Brazil, 24-29 Jun. 1990
(INPE-5176-PRE/1645) Avail: NTIS HC/MF A03

Procedures are summarized in satellite image interpretation as well as weathering index data of several soils in the Piracicaba region (SP), combined in an integrated form. The aim is to apply remote sensing techniques to correlate the depth of the alteration mantle, establish parameters, their controls, and possible reflexes in the tonal and textural characteristics of the LANDSAT-TM.
Author

N91-21619# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
SPECTRAL CHARACTERISTICS OF AGRICULTURAL CROPS AND YIELD Final Report [CARACTERISTICAS ESPECTRAIS DE CULTURAS E RENDIMENTO AGRICOLA]
Antonio Roberto Formaggio and Jose Carlos NevesEpiphanio May 1990 179 p In PORTUGUESE; ENGLISH summary Presented at the INPE/FIBGE Conference, 1989
(INPE-5125-RPE/630) Avail: NTIS HC/MF A09

Some activities developed under the grant INPE/FIBGE are described. There are some works conducted with the data obtained in two field missions along 1986 and 1987. An extensive literature review about remote sensing applied to agriculture is presented with the theory involved. Also, the use of radiometry and TM/LANDSAT data applied to the study of wheat and beans is presented.
Author

N91-21620# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
CHARACTERIZATION OF ANTROPIC ACTION IN THE MEARIM (MA) MIDDLE-LOW VALLEY THROUGH LANDSAT/TM IMAGERY [CARACTERIZACAO DA ACAO ANTROPICA NUM TRECHO DO MEDIO-BAIXO VALE DO RIO MEARIM (MA) ATRAVES DE IMAGENS LANDSAT-TM]
Maria Lucia BritoCruz, Maria Eugenia Mazzocato, and Tania Maria Sausen 30 May 1990 52 p In PORTUGUESE; ENGLISH summary Presented at the 6th Brazilian Symposium on Remote Sensing, Manaus, Brazil, 24-29 Jun. 1990
(INPE-5075-PRE/1594) Avail: NTIS HC/MF A04

The existing lakes in the fluvial plain of the Mearim River middle-low valley, are significant food producer areas to migratory birds. The objective is to characterize and evaluate the impact of the antropic action in this region, through LANDSAT/TM imagery, to support the elaboration of a reasonable-integrated settlement of the area in order to preseve the area. Multispectral images corresponding to bands TM 3, 4, and 5 of low water and high water periods in 1985, 1986, and 1987 were analyzed considering the drainage network and the land use evaluation in the watershed. They also used precipitation data from 1973 to 1988, topographic maps, and the Geological Information System. At the end of the study it was possible to conclude that the deforestation in the study area is occurring at an accelerated pace. Besides the deforestation, the existence of a high index of burning areas was also observed which facilitates the erosion process and can change the lake water quality. Author

N91-21621* National Aeronautics and Space Administration. Pasadena Office, CA.
SYSTEM AND METHOD FOR MEASURING OCEAN SURFACE CURRENTS AT LOCATIONS REMOTE FROM LAND MASSES USING SYNTHETIC APERTURE RADAR Patent
Lawrence E. Young, inventor (to NASA) 5 Feb. 1991 7 p Filed 14 Mar. 1990 Supersedes N91-13787 (29 - 5, p 681)
(Contract NAS7-918)
(NASA-Case-NPO-17937-1-CU; US-Patent-4,990,922;
US-Patent-Appl-SN-493190; US-Patent-Class-342-52;
US-Patent-Class-342-26; US-Patent-Class-342-357;
Int-Patent-Class-G01S-13/86; Int-Patent-Class-G01S-13/89)
Avail: US Patent and Trademark Office CSCL 08C

A system for measuring ocean surface currents from an airborne platform is disclosed. A radar system having two spaced antennas wherein one antenna is driven and return signals from the ocean surface are detected by both antennas is employed to get raw ocean current data which are saved for later processing. There are a pair of global positioning system (GPS) systems including a first antenna carried by the platform at a first location and a second antenna carried by the platform at a second location displaced from the first antenna for determining the position of the antennas from signals from orbiting GPS navigational satellites. Data are also saved for later processing. The saved data are subsequently processed by a ground-based computer system to determine the position, orientation, and velocity of the platform as well as to derive measurements of currents on the ocean surface.
Official Gazette of the U.S. Patent and Trademark Office

N91-21622# Oulu Univ. (Finland). Research Inst. of Northern Finland.
SUPERVISION OF PEAT STOCKPILES USING AERIAL THERMOGRAPHY
Matti Tervo and Boris Segerstahl, ed. 1990 114 p In FINNISH, ENGLISH summary
(DE91-752966; OY/PSTL-RR-100; ISBN-951-42-2969-X;
ISSN-0785-4501) Avail: NTIS HC/MF A06

This work concerns the technical and economic feasibility of aerial infrared thermography for observing spontaneous heat generation in peat stockpiles. The theoretical section is concerned with the physical basis of heat radiation, the measuring instruments and the special features of aerial infrared thermography. The effects of weather on the results of thermography are also discussed. The technical applicability of infrared thermography was studied by taking about 2800 thermograms of peat stockpiles during the autumns of 1987 to 1989 and using these to measure the inside temperatures of 200 stockpiles on peatbogs. These data show that it is possible to observe spontaneous heat generation in peat stockpiles from an aeroplane quite reliably by means of thermograms and that this can be done at an early stage, long before there is any risk of self-ignition. The method is applicable technically to both sod peat and milled peat. A set of recommendations for the aerial thermographing of peat stockpiles is developed, including recommendations on equipment, the thermographing process, the most suitable weather conditions and for interpretation of the thermograms. The costs of aerial thermography are compensated for by savings obtained from the minimization of peat losses due to spontaneous heat generation and fires. If the storage time of the self-heating stockpiles identified by aerial thermography can be made reduced by earlier transporting of the peat to the user, the resulting savings will cover the costs of the thermography. This is shown to have been possible under the circumstances prevailing in autumn 1989. DOE

N91-21623# Army Engineer Topographic Labs., Fort Belvoir, VA.
DESIGN AND DEVELOPMENT OF THE TERRAIN INFORMATION EXTRACTION SYSTEM Scientific Paper, 23 - 27 Jul. 1990
Gregory B. Desmond and Daniel L. Edwards 4 Sep. 1990 12 p
(AD-A231166; ETL-R-153) Avail: NTIS HC/MF A03 CSCL 08/2

A program has been initiated for the design and development of a Terrain Information Extraction System (TIES). This is a test-bed system which will integrate many diverse capabilities drawn from the fields of photogrammetry, remote sensing, automated cartography, and geographic information systems; all within a distributed, digital environment. TIES will be an extensible, modular system which will be used to develop more responsive and reliable techniques to generate digital terrain databases. The system will provide a beginning-to-end mapping and exploitation capability utilizing a number of digital and digitized image source materials to collect data needed for various military and civilian activities. These activities include wetlands delineation and water resources management. TIES is being developed on commercial off-the-shelf hardware, and will incorporate both proprietary and public domain software. Major components of the system include an image scanner, a digital stereo photogrammetric workstation, and a geographic information system. GRA

N91-21624# Air Force Geophysics Lab., Hanscom AFB, MA.
THE HEMISPHERIC EIGHTH MESH TERRAIN ELEVATION AND GEOGRAPHY DATA SETS
Crystal B. Schaaf, Joan M. Ward, H. S. Muench, Robert P. DEntremont, and Michael K. Griffin 4 Sep. 1990 15 p
(AD-A231592; GL-TR-90-0223; GL-SR-263) Avail: NTIS HC/MF A03 CSCL 08/6

A number of meteorological models at the Air Force Global Weather Central (AFGWC) make use of eighth mesh resolution terrain elevation and geography (land/coastline/water) data sets. Unfortunately, the data sets currently in use at AFGWC are of extremely poor quality. Therefore, as part of GL efforts to upgrade the Real-Time Nephanalysis Model, new hemispheric eighth mesh (approx. 25 nautical mile resolution) data sets were developed. The global Navy 10 arc minute terrain elevation and land characteristics data (approx. 10 nautical mile resolution) were used as source data. The averaging and remapping techniques used in the development of these new accurate hemispheric data sets are described. GRA

44 ENERGY PRODUCTION AND CONVERSION

Includes specific energy conversion systems, e.g., fuel cells; global sources of energy; geophysical conversion; and windpower.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *28 Propellants and Fuels.*

N91-21625*# Cornell Univ., Ithaca, NY.
HISTORICAL DEVELOPMENT OF THE WINDMILL Final Report
Dennis G. Shepherd (Sverdrup Technology, Inc., Brook Park, OH.) Washington NASA Dec. 1990 49 p Submitted for publication Joint project of DOE/NASA, Lewis Research Center (Contracts NAS3-25266; DE-AI01-76ET-20320)
(NASA-CR-4337; E-5664; DOE/NASA/5266-2; NAS 1.26:4337) Avail: NTIS HC/MF A03 CSCL 10A

Throughout history, windmill technology represented the highest levels of development in those technical fields now referred to as mechanical engineering, civil engineering, and aerodynamics. Key stages are described in the technical development of windmills as prime movers; from antiquity to construction of the well known Smith-Putnam wind turbine generator of the 1940's, which laid the foundation for modern wind turbines. Subjects covered are windmills in ancient times; the vertical axis Persian windmill; the horizontal axis European windmill (including both post mills and tower mills); technology improvements in sails, controls, and analysis; the American farm windmill; the transition from windmills to wind turbines for generating electricity at the end of the 19th century; and wind turbine development in the first half of the 20th century. Author

45 ENVIRONMENT POLLUTION

Includes atmospheric, noise, thermal, and water pollution.

N91-21626# National Oceanic and Atmospheric Administration, Boulder, CO. Climate Monitoring and Diagnostics Lab.
ATMOSPHERIC METHANE DATA FOR THE PERIOD 1986-1988 FROM THE NOAA/CMDL GLOBAL COOPERATIVE FLASK SAMPLING NETWORK
P. M. Lang, L. P. Steele, and R. C. Martin Oct. 1990 115 p Prepared in cooperation with Commonwealth Scientific and Industrial Research Organization, Aspendale
(PB91-129122; NOAA-TM-ERL-CMDL-2) Avail: NTIS HC/MF A06 CSCL 13B

The memorandum builds on previous work (Lang et al., 1987) to extend by three years the record of atmospheric methane measurements made through the NOAA/CMDL cooperative flask sampling network. The format of the data presentations given here follows very closely that used by Lang et al., (1990). Details of the flask sampling methods and the analytical and calibrational procedures are given. Results from individual flask samples are both tabulated and plotted. Monthly average methane concentrations at each site are also tabulated. GRA

N91-21627# National Oceanic and Atmospheric Administration, Boulder, CO.
ENVIRONMENTAL RESEARCH LABORATORIES PUBLICATION ABSTRACTS, FISCAL YEAR 1990
Oct. 1990 218 p
(PB91-132035) Avail: NTIS HC/MF A10 CSCL 13B

The following subject areas are covered: a guide for users; aeronomy laboratory; air resources laboratory; Atlantic oceanographic and meteorological laboratory; climate monitoring and diagnostics laboratory; forecast systems laboratory; geophysical fluid dynamics laboratory; Great Lakes environmental research laboratory; National severe storms laboratory; Pacific Marine environmental laboratory; Space environment laboratory; and wave propagation laboratory. Author

N91-21628# Armenian Engineers and Scientists of America, Inc., Glendale, CA.
ENVIRONMENT FACT FINDING MISSION REPORT
A. Gharabegian, S. Adamian, L. Derian, H. Yacoub, and L. Saryan Aug. 1990 95 p
(PB91-130369; AESA-EN1-890) Avail: NTIS HC/MF A05 CSCL 13B

Environmental pollution problems within the Republic of Armenia have been of concern to the people for over a decade. It is no secret that serious environmental concerns currently confront East Europe and the U.S.S.R. as a whole. Armenia's situation may be seen as a micrososm of these problems, stemming from some of the same root causes inherent in the Soviet economic and socio-political system. Armenia has a number of specific problems that arise from factors unique to its geography and economic development over the past seven decades. Environmental scientists in the West have found it difficult to obtain reliable information about the nature and extent of Armenia's environmental situation. A two-week fact-finding mission to Armenia could not hope to investigate all environmental problems or begin to solve them, but it would serve the important purpose of establishing personal contacts between experts in the West and those working in Armenia and begin to address some problems. The findings of the AESA team and their recommended projects are summarized. GRA

N91-21629# Minnesota Univ., Minneapolis. Dept. of Civil and Mining Engineering.
FIELD INTERCOMPARISON OF PRECIPITATION SAMPLERS FOR ASSESSING WET DEPOSITION OF ORGANIC CONTAMINANTS Final Report
S. J. Eisenreich, T. P. Franz, and M. B. Swanson Mar. 1990 126 p Sponsored in part by EPA, Chicago, IL
(Grant R-005840)
(PB91-125880; GLNPO-01/90; EPA/905/4-90/002) Avail: NTIS HC/MF A07 CSCL 13B

A field intercomparison of four wet-only precipitation samplers was performed to assess their ability to efficiently collect rain and selected organic contaminants. Samplers are evaluated and compared on the basis of their ability to efficiently collect rainfall, exhibit mechanical reliability, demonstrate adequate operational characteristics, and provide precise measures of wet-only input. The sampler intercomparison was conducted in part to select the preferred characteristics of a rain sampler that must be deployed in the field unattended for up to two weeks. The results of this intercomparison are presented. Author

N91-21630# Office of Air Quality Planning and Standards, Research Triangle Park, NC.
COMPILATION OF AIR POLLUTANT EMISSION FACTOR. VOLUME 1, SUPPLEMENT C: STATIONARY POINT AND AREA SOURCES, FOURTH EDITION
Whitmel M. Joyner, ed. Sep. 1990 170 p
(PB91-125906; AP-42-Suppl-C-Vol-1) Avail: NTIS HC/MF A08 CSCL 13B

In the Supplement to the Fourth Edition of AP-42, new or revised emissions data are presented for residential wood stoves; refuse combustion; sewage sludge incineration; magnetic tape manufacturing industry; surface coating of plastic parts for business machines; synthetic fiber manufacturing; primary lead smelting; gray iron foundries; chemical wood pulping; wildfires and prescribed burning; industrial paved roads; industrial wind erosion; explosives detonation' Appendix C.2, 'Generalized Particle Size Distributions'; Appendix D, 'Procedures for Sampling Surface/Bulk Dust Loading'; and Appendix E, 'Procedures for Laboratory Analysis of Surface/Bulk Dust Loading Samples'. GRA

N91-21631# Environmental Protection Agency, Research Triangle Park, NC. Atmospheric Research and Exposure Assessment Lab.

ADAPTATION OF THE ADVANCED STATISTICAL TRAJECTORY REGIONAL AIR POLLUTION (ASTRAP) MODEL TO THE EPA VAX COMPUTER: MODIFICATIONS AND TESTING Final Report, Feb. 1988 - Jun. 1989

Terry L. Clark and Dale H. Coventry (National Oceanic and Atmospheric Administration, Boulder, CO.) Nov. 1990 44 p
(PB91-127720; EPA/600/3-90/083) Avail: NTIS HC/MF A03 CSCL 13B

The Advanced Statistical Trajectory Regional Air Pollution (ASTRAP) model simulates long-term transport and deposition of oxides of sulfur and nitrogen. It is a potential screening tool for assessing long-term effects on regional visibility from sulfur emission sources. However, a rigorous evaluation is required before the model can be recommended for the particular application. As a first step, the original 1985 IBM-3033 version of the model was modified to create the ASTRAP-EPA version for applications on the EPA VAX-8600 computer using existing EPA preprocessed meteorological and emissions data files. Additional modifications improved the model design by eliminating several model assumptions and replacing some modeling approaches. The cumulative effect of the model modifications was assessed by comparing the quarterly 1980 calculations of sulfur wet deposition of both versions with screened measurements. The seasonal correlation coefficients and standard errors of each model, version are insignificantly different at the 0.05 level, demonstrating that the two model versions indeed produce similar results. In general, the improvements in model design only slightly enhance model performance. Sensitivity of ASTRAP-EPA calculations of sulfur wet deposition was also assessed for several model assumptions and values of model parameters. ASTRAP-EPA model predictions are most sensitive to three parameters - the model time step, the truncation of trajectories near the border of wind-data-void regions, and the temporal aggregation of ensemble trajectory statistics. The maximum quarterly predictions of sulfur wet deposition, across southwestern Pennsylvania and northern West Virginia, decrease by as much as 30 percent when either the model time step changes from 3 to 6 hours, or when trajectories are not truncated, or when trajectory statistics are not temporally aggregated. GRA

N91-21632# Forest Service, Asheville, NC. Southeastern Forest Experiment Station.

CLIMATE VARIABILITY AND ECOSYSTEM RESPONSE: PROCEEDINGS OF A LONG-TERM ECOLOGICAL RESEARCH WORKSHOP

D. Greenland and L. W. Swift Oct. 1990 95 p Workshop held in Boulder, CO, 21-23 Aug. 1988
(PB91-119180; FSGTR-SE-65) Avail: NTIS HC/MF A05 CSCL 13B

Nine papers describe studies of climate variability and ecosystem response. The studies were conducted at LTER (Long Term Ecological Research) sites representing forest, agricultural, and aquatic ecosystems and systems in which extreme climates limit vegetational cover. An overview paper prepared by the LTER Climate Committee stresses the importance of (1) clear definition of terms, (2) use of appropriate temporal and spatial scales, (3) development of new and more useful indices of climate, and (4) opportunities to take scientific advantage of differences and similarities among LTER sites. Author

N91-21633*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

ATMOSPHERIC ENVIRONMENT FOR SPACE SHUTTLE (STS-38) LAUNCH

G. L. Jasper and G. W. Batts (New Technology, Inc., Huntsville, AL.) Feb. 1991 44 p
(NASA-TM-103530; NAS 1.15:103530) Avail: NTIS HC/MF A03 CSCL 13B

A summary of selected atmospheric conditions observed near space shuttle STS-38 launch time on November 15, 1990, at Kennedy Space Center is presented. STS-38 carried a Department of Defense payload and the flight azimuth in this report will be denoted by a reference flight azimuth, since the actual flight azimuth is not known. Values of ambient pressure, temperature, moisture, ground winds, visual observation (cloud), and winds aloft are included. The sequence of prelaunch Jimsphere-measured vertical wind profiles is presented. The final atmospheric tape, which consists of wind and thermodynamic parameters versus altitude, for STS-38 vehicle ascent was constructed. The STS-38 ascent atmospheric data tape was constructed by Marshall Space Flight Center's Earth Science and Applications Division to provide an internally consistent data set for use in postflight performance assessments and represents the best estimate of the launch environment to the 400,000-ft altitude that was traversed by the STS-38 vehicle. Author

N91-21634# Oak Ridge National Lab., TN.

SEMINAR ON ANTHROPOGENIC EMISSIONS OF GREENHOUSE GASES

G. H. Marland 28 Feb. 1991 30 p
(Contract DE-AC05-84OR-21400)
(DE91-009110; ORNL/FTR-3867) Avail: NTIS HC/MF A03

The traveler participated in an Organization for Economic Cooperation and Development (OECD) expert seminar on anthropogenic emissions of greenhouse gases. The meeting was initiated by OECD in anticipation of the need for national estimating of emissions of greenhouse gases which will precede an international convention on greenhouse gases. The meeting which attracted delegates from 44 countries, began the process of developing a standardized methodology and a set of guidelines so that individual countries can calculate their own emissions of greenhouse gases in a way that is transparent and comparable among nations. The meeting considered all anthropogenic sources of CO2, CH4, and N2O, and some other chemically active gases but specifically left chlorofluorocarbons (CFCs) for other international processes. The traveler had an opportunity to review the background document for the meeting and was invited to open the working session on CO2 emissions from combustion sources by summarizing and critiquing the background document. The meeting concluded with a commitment to complete a guidelines document to be published by OECD. There was tentative accord that some developing nations would require technical assistance to complete such an inventory while some developed nations would be willing to provide that assistance. DOE

N91-21635*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, FL.

DYNAMICS OF VEGETATION AND SOILS OF OAK/SAW PALMETTO SCRUB AFTER FIRE: OBSERVATIONS FROM PERMANENT TRANSECTS

Paul A. Schmalzer and G. Ross Hinkle (Bionetics Corp., Cocoa Beach, FL.) 25 Jan. 1991 162 p
(Contract NAS10-11624)
(NASA-TM-103817; NAS 1.15:103817) Avail: NTIS HC/MF A08 CSCL 13B

Ten permanent 15 m transects previously established in two oak/saw palmetto scrub stands burned in December 1986, while two transects remained unburned. Vegetation in the greater than 0.5 m and the less than 0.5 m layers on these transects was sampled at 6, 12, 18, 24, and 36 months postburn and determined structural features of the vegetation (height, percent bare ground, total cover). The vegetation data were analyzed from each sampling by height layer using detrended correspondence analysis ordination. Vegetation data for the greater than 0.5 m layer for the entire time sequence were combined and analyzed using detrended correspondence analysis ordination. Soils were sampled at 6, 12, 18, and 24 months postburn and analyzed for pH, conductivity, organic matter, exchangeable cations (Ca, Mg, K, Na), NO3-N, NH4-N, Al, available metals (Cu, Fe, Mn, Zn), and PO4-P. Shrub species recovered at different rates postfire with saw palmetto reestablishing cover greater than 0.5 m within one year, but the scrub oaks had not returned to preburn cover greater than 0.5 m in 3 years after the fire. These differences in growth rates resulted in dominance shifts after the fire with saw palmetto increasing

relative to the scrub oaks. Overall changes in species richness were minor, although changes occurred in species richness by height layers due to different growth rates. Soils of well drained and poorly drained sites differed markedly. Soil responses to the fire appeared minor. Soil pH increased at 6 and 12 months postfire; calcium increased at 6 months postburn. Nitrate-nitrogen increased at 12 months postburn. Low values of conductivity, PO4-P, Mg, K, Na, and Fe at 12 months postburn may be related to heavy rainfall the preceding month. Seasonal variability in some soil parameters appeared to occur. Author

N91-21636# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
EVALUATION OF INDIGENOUS AREAS UTILIZING TM/LANDSAT DATA [AVALIACAO DE AREAS INDIGENAS UTILIZANDO-SE DADOS TM/LANDSAT]
Pedro Hernandez Filho and Kleber deFaria (Fundacao de Ciencia, Aplicacoes e Technologia Espaciais, Sao Jose dos Campos, Brazil) Nov. 1990 9 p In PORTUGUESE; ENGLISH summary Presented at the 6th Brazilian Symposium on Remote Sensing, Manaus, Brazil, 24-29 Jun. 1990
(INPE-5173-PRE/1642) Avail: NTIS HC/MF A02

The objective is to provide environmental information about indigenous areas. The study area is located in Boa Vista, Bonfim e Alto Alegre in Roraima Territory, Brazil. Based on visual analysis of TM/LANDSAT data, several classes of vegetation associated with the land use were defined. The results show the possibilities and limitations of spatial technology to know the land use and environment risk. Author

N91-21637# Oak Ridge National Lab., TN.
USING CLIMATE MODEL OUTPUT TO ASSESS THE IMPACTS OF CLIMATE CHANGE ON WATER RESOURCES
R. M. Cushman 1990 5 p Presented at the 18th National Conference on Water Resources Planning and Management, New Orleans, 20-22 May 1991
(Contract DE-AC05-84OR-21400)
(DE91-004542; CONF-910575-1) Avail: NTIS HC/MF A01

The use of general circulation models (GCMs) to provide climate data for regional assessments of the impacts of changing climate on water resources stretches the limits of what the models were designed for. Problems that must be addressed include disagreement on a regional scale among GCMs and between the modeled and observed climate; coarse spatial resolution of the models; and simplistic representation of surface hydrology. It is important that continued progress be made in developing the methodology for using GCM output in climate-impact assessments. DOE

N91-21638# Lawrence Livermore National Lab., CA.
USER'S MANUAL FOR SLAB: AN ATMOSPHERIC DISPERSION MODEL FOR DENSER-THAN-AIR-RELEASES
D. L. Ermak Jun. 1990 137 p
(Contract W-7405-eng-48)
(DE91-008443; UCRL-MA-105607) Avail: NTIS HC/MF A07

SLAB is a computer model that simulates the atmospheric dispersion of denser-than-air releases. The types of releases treated by the model include a ground-level evaporating pool, an elevated horizontal jet, a stack or elevated vertical jet, and an instantaneous volume source. Except for the evaporating pool source which is assumed to be all vapor, all of the remaining sources may be either pure vapor or a mixture of vapor and liquid droplets. Atmospheric dispersion of the release is calculated by solving the conversation equation of mass, momentum, energy, and species. The conservation equations are spatially averaged so as to treat the cloud as either a steady state plume, a transient puff, or a combination of the two depending upon the duration of the release. The mathematical description of the physics of heavy gas dispersion (gravity spread, reduced turbulent mixing, etc.) as well as the description of the normal atmospheric advection and turbulent diffusion processes, are inherently included in the conservation equations. The time-averaged concentration predicted by SLAB depends on not only the various physical phenomena associated with the dispersion equations, but also on the specified concentration averaging time. Typical dispersion simulations require only a few minutes on an IBM-AT class personal computer. This report presents a theoretical description of the model, guidance for running the model and interpreting the results, and four example problems to illustrate the use of the model. DOE

N91-21639# New York Univ., New York. Dept. of Applied Science.
CLOUD AND OCEAN EFFECTS ON GLOBAL GREENHOUSE WARMING
M. I. Hoffert Feb. 1991 4 p
(Contract DE-FG02-90ER-61014)
(DE91-008842; DOE/ER-61014/1) Avail: NTIS HC/MF A01

A new generation of transient climate/ocean model were developed which are capable of reflecting feedbacks associated with clouds and ocean dynamics, and they are used to better constrain the transient climate response to increased greenhouse gas concentrations in the atmosphere. This is a necessary step in quantifying the links between radiative forcing of the atmosphere and climate response on 10 to 100 year time scales. The modelling work involves, on the one hand, developing a better characterization of cloud forcing and feedback, and on the other, a new generation of ocean/climate model incorporating feedbacks from the changing stratification of the ocean as heat is absorbed during periods of global warming. DOE

N91-21643*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
CLIMATIC IMPACT OF VOLCANIC ERUPTIONS
Michael R. Rampino *In its* Volcanism-Climate Interactions Feb. 1991 8 p (For primary document see N91-21641 13-46)
Avail: NTIS HC/MF A07 CSCL 13B

N91-21646*# Maryland Univ., College Park. Dept. of Meteorology.
VOLCANIC EFFECTS ON CLIMATE
Alan Robock *In* NASA, Goddard Space Flight Center, Volcanism-Climate Feb. 1991 Interactions19 p (For primary document see N91-21641 13-46)
Avail: NTIS HC/MF A07 CSCL 13B

46 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism.

For space radiation see *93 Space Radiation.*

N91-21640*# Joint Oceanographic Inst., Inc., Washington, DC.
POLAR RESEARCH FROM SATELLITES
Robert H. Thomas 1991 96 p Sponsored by NASA Original contains color illustrations
(NASA-CR-188025; NAS 1.26:188025) Avail: NTIS HC/MF A05; 8 functional color pages CSCL 04A

In the polar regions and climate change section, the topics of ocean/atmosphere heat transfer, trace gases, surface albedo, and response to climate warming are discussed. The satellite instruments section is divided into three parts. Part one is about basic principles and covers, choice of frequencies, algorithms, orbits, and remote sensing techniques. Part two is about passive sensors and covers microwave radiometers, medium-resolution visible and infrared sensors, advanced very high resolution radiometers, optical line scanners, earth radiation budget experiment, coastal zone color scanner, high-resolution imagers, and atmospheric sounding. Part three is about active sensors and covers synthetic aperture radar, radar altimeters, scatterometers, and lidar. There is also a next decade section that is followed by a summary and recommendations section. K.S.

N91-21641*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
VOLCANISM-CLIMATE INTERACTIONS

Louis S. Walter, ed. and Shanaka deSilva, ed. (Lunar and Planetary Inst., Houston, TX.) Washington Feb. 1991 145 p Workshop held in College Park, MD, 18-19 Jun. 1990
(NASA-CP-10062; Rept-91B00055; NAS 1.55:10062) Avail: NTIS HC/MF A07 CSCL 08K

The range of disciplines in the study of volcanism-climate interactions includes paleoclimate, volcanology, petrology, tectonics, cloud physics and chemistry, and climate and radiation modeling. Questions encountered in understanding the interactions include: the source and evolution of sulfur and sulfur-gaseous species in magmas; their entrainment in volcanic plumes and injection into the stratosphere; their dissipation rates; and their radiative effects. Other issues include modeling and measuring regional and global effects of such large, dense clouds. A broad-range plan of research designed to answer these questions was defined. The plan includes observations of volcanoes, rocks, trees, and ice cores, as well as satellite and aircraft observations of erupting volcanoes and resulting lumes and clouds. For individual titles, see N91-21642 through N91-21646.

N91-21642*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
HISTORICAL EVIDENCE FOR A CONNECTION BETWEEN VOLCANIC ERUPTIONS AND CLIMATE CHANGE
Michael R. Rampino (New York Univ., New York.) *In its* Volcanism-Climate Interactions Feb. 1991 2 p (For primary document see N91-21641 13-46)
Avail: NTIS HC/MF A07 CSCL 08K

The times of historical volcanic aerosol clouds were compared with changes in atmospheric temperatures on regional, hemispheric, and global scales. These involve either a direct comparison of individual significant eruption years with temperature records, or a comparison of eruption years with composited temperature records for several years before and after chosen sets of eruptions. Some studies have challenged the connection between individual eruptions and climate change. Mass and Portman (1989) recently suggested that the volcanic signal was present, but smaller than previously thought. In a study designed to test the idea that eruptions could cause small changes in climate, Hansen and other (1978) chose one of the best monitored eruptions at the time, the 1963 eruption of Agung volcano on the island of Bali. Using a simple radiation-balance model, in which an aerosol cloud in the tropics was simulated, this basic pattern of temperature change in the tropics and subtropics was reproduced. There may be natural limits to the atmospheric effects of any volcanic eruption. Self-limiting physical and chemical effects in eruption clouds were proposed. Model results suggest that aerosol microphysical processes of condensation and coagulation produce larger aerosols as the SO2 injection rate is increased. The key to discovering the greatest effects of volcanoes on short-term climate may be to concentrate on regional temperatures where the effects of volcanic aerosol clouds can be amplified by perturbed atmospheric circulation patterns, especially changes in mid-latitudes where meridional circulation patterns may develop. Such climatic perturbations can be detected in proxy evidence such as decreases in tree-ring widths and frost damage rings in climatically sensitive parts of the world, changes in treelines, weather anomalies such as unusually cold summers, severity of sea-ice in polar and subpolar regions, and poor grain yields and crop failures. Author

N91-21643*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
CLIMATIC IMPACT OF VOLCANIC ERUPTIONS **c45**
Michael R. Rampino *In its* Volcanism-Climate Interactions Feb. 1991 8 p (For primary document see N91-21641 13-46)
Avail: NTIS HC/MF A07 CSCL 13B

Studies have attempted to 'isolate' the volcanic signal in noisy temperature data. This assumes that it is possible to isolate a distinct volcanic signal in a record that may have a combination of forcings (ENSO, solar variability, random fluctuations, volcanism) that all interact. The key to discovering the greatest effects of volcanoes on short-term climate may be to concentrate on temperatures in regions where the effects of aerosol clouds may be amplified by perturbed atmospheric circulation patterns. This is especially true in subpolar and midlatitude areas affected by changes in the position of the polar front. Such climatic perturbation can be detected in proxy evidence such as decrease in tree-ring widths and frost rings, changes in the treeline, weather anomalies, severity of sea-ice in polar and subpolar regions, and poor grain yields and crop failures. In low latitudes, sudden temperature drops were correlated with the passage overhead of the volcanic dust cloud (Stothers, 1984). For some eruptions, such as Tambora, 1815, these kinds of proxy and anectdotal information were summarized in great detail in a number of papers and books (e.g., Post, 1978; Stothers, 1984; Stommel and Stommel, 1986; C. R. Harrington, in press). These studies lead to the general conclusion that regional effects on climate, sometimes quite severe, may be the major impact of large historical volcanic aerosol clouds. Author

N91-21644*# Rhode Island Univ., Narragansett. Graduate School of Oceanography.
SOURCES OF VOLCANIC AEROSOLS: PETROLOGIC AND VOLCANOLOGICAL CONSTRAINTS
Haraldur Sigurdsson *In* NASA, Goddard Space Flight Center, Volcanism-Climate Interactions Feb. 1991 37 p (For primary document see N91-21641 13-46)
Avail: NTIS HC/MF A07 CSCL 08K

Global climatic effects brought about by volcanism are related to the impact of volcanic gases and their derivative aerosols on the atmosphere, rather than the effects of volcanic ash. Evidence from both historic eruptions and polar ice cores indicate that volcanic sulfur gases are the dominant aerosol-forming component, resulting in produciton of a sulfuric acid-rich stratosphere aerosol that can have profound effects on the earth radiation budget over periods of a few years. Due to highly variable sulfur content of different magma types, the climatic effects do not relate simply to total erupted mass. There is a close relationship between volcanic sulfur yield to the atmospheric and hemispheric surface temperature decrease following an eruption, with up to 1 C surface temperature decrease indicated following a major volcanic event such as the 1815 Tambora eruption. While the erupted mass of HCl and HF is equal to or greater than that of sulfur gases in some volcanic events, the halogens do not form known aerosols nor are they abundant in ice core acidity layers. The early removal of halogens from eruption columns occurs by rain flushing and adsorption onto tephra particles, but the fate of halogens in the atmosphere following very large explosive eruptions is unknown. The CO2 flux to the atmosphere from volcanic eruptions is volumetrically one of the most important of the gas species, but owing to the huge size of the atmospheric reservoir of this gas, the volcanic contribution is likely to have negligible effects. Author

N91-21645*# California Univ., Los Angeles. Dept. of Atmospheric Sciences.
VOLCANIC AEROSOLS: CHEMISTRY, EVOLUTION, AND EFFECTS
Richard Turco *In* NASA, Goddard Space Flight Center, Volcanism-Climate Interactions Feb. 1991 30 p (For primary document see N91-21641 13-46)
Avail: NTIS HC/MF A07 CSCL 08K

Stratospheric aerosols have been the subject of scientific speculation since the 1880s, when the powerful eruption of Krakatoa attracted worldwide attention to the upper atmosphere through spectacular optical displays. The presence of a permanent tenuous dust layer in the lower stratosphere was postulated in the 1920s following studies of the twilight glow. Junge collected the first samples of these 'dust' particles and demonstrated that they were actually composed of sulfates, most likely concentrated sulfuric acid (Junge and Manson, 1961; Junge, 1963). Subsequent research has been spurred by the realization that stratospheric particles can influence the surface climate of earth through their effects on atmospheric radiation. Such aerosols can also influence, through chemical and physical effects, the trace composition of the atmosphere, ozone concentrations, and atmospheric electrical properties. The properties of stratospheric aerosols (both the

background particles and those enhanced by volcanic eruptions) were measured in situ by balloon ascents and high altitude aircraft sorties. The aerosols were also observed remotely from the ground and from satellites using both active (lidar) and passive (solar occultation) techniques (remote sensing instruments were carried on aircraft and balloon platforms as well). In connection with the experimental work, models were developed to test theories of particle formation and evolution, to guide measurement strategies, to provide a means of connecting laboratory and field data, and to apply the knowledge gained to answer practical questions about global changes in climate, depletion of the ozone layer, and related environmental problems. Author

N91-21646*# Maryland Univ., College Park. Dept. of Meteorology.
VOLCANIC EFFECTS ON CLIMATE c45
Alan Robock *In* NASA, Goddard Space Flight Center, Volcanism-Climate Feb. 1991 Interactions19 p (For primary document see N91-21641 13-46)
Avail: NTIS HC/MF A07 CSCL 13B

Volcanic eruptions which inject large amounts of sulfur-rich gas into the stratosphere produce dust veils which last years and cool the earth's surface. At the same time, these dust veils absorb enough solar radiation to warm the stratosphere. Since these temperature changes at the earth's surface and in the stratosphere are both in the opposite direction of hypothesized effects from greenhouse gases, they act to delay and mask the detection of greenhouse effects on the climate system. Tantalizing recent research results have suggested regional effects of volcanic eruptions, including effects on El Nino/Southern Oscillation (ENSO). In addition, a large portion of the global climate change of the past 100 years may be due to the effects of volcanoes, but a definite answer is not yet clear. While effects of several years were demonstrated with both data studies and numerical models, long-term effects, while found in climate model calculations, await confirmation with more realistic models. Extremely large explosive prehistoric eruptions may have produced severe weather and climate effects, sometimes called a 'volcanic winter'. Complete understanding of the above effects of volcanoes is hampered by inadequacies of data sets on volcanic dust veils and on climate change. Space observations can play an increasingly important role in an observing program in the future. The effects of volcanoes are not adequately separated from ENSO events, and climate modeling of the effects of volcanoes is in its infancy. Specific suggestions are made for future work to improve the knowledge of this important component of the climate system. Author

N91-21647# National Oceanic and Atmospheric Administration, Boulder, CO. Wave Propagation Lab.
CALIBRATION TRANSFER TARGET FOR A MICROWAVE RADIOMETRIC PROFILING SYSTEM
J. Jordan and M. Decker Nov. 1990 19 p
(PB91-129080; NOAA-TM-ERL-WPL-189) Avail: NTIS HC/MF A03 CSCL 04A

The Wave Propagation Laboratory has been operating a six-channel radiometer profiler since 1981 at Stapleton International Airport in Denver, Colorado, to retrieve temperature profiles. The atmospheric absorption at these frequencies is too large for tipping calibrations to be used. Therefore, data from collocated National Weather Service radiosondes were used to calibrate the radiometric profiles. The technique provides the necessary profiler calibration but limits its use to locations with regular radiosonde launches. Therefore, a prototype calibration transfer target was constructed at Stapleton Airport to demonstrate the feasibility of using the target to help maintain a network of radiometric profilers not located at radiosonde sites. The calibration target is described, along with potential error sources. GRA

N91-21648*# National Oceanic and Atmospheric Administration, Boulder, CO. Wave Propagation Lab.
ESTIMATIONS OF ABL FLUXES AND OTHER TURBULENCE PARAMETERS FROM DOPPLER LIDAR DATA Status Report, 1 Jun. - 30 Nov. 1990
Gal-Chen Tzvi, Xu Mei (Oklahoma Univ., Norman.), and Wynn Eberhard 1990 55 p
(Grant NAG5-1379)
(NASA-CR-188062; NAS 1.26:188062) Avail: NTIS HC/MF A04 CSCL 04A

Techniques for extracting boundary layer parameters from measurements of a short pulse CO2 Doppler Lidar are described. The radial velocity measurements have a range resolution of 150 m. With a pulse repetition rate of 20 Hz, it is possible to perform scannings in two perpendicular vertical planes in approx. 72 s. By continuously operating the Lidar for about an hour, one can extract stable statistics of the radial velocities. Assuming that the turbulence is horizontally homogeneous, the mean wind, its standard deviations, and the momentum fluxes were estimated. From the vertically pointing beam, the first, second, and third moments of the vertical velocity were also estimated. Spectral analysis of the radial velocities is also performed from which, by examining the amplitude of the power spectrum at the inertial range, the kinetic energy dissipation was deduced. Finally, using the statistical form of the Navier-Stokes equations, the surface heat flux is derived as the residual balance between the vertical gradient of the third moment of the vertical velocity and the kinetic energy dissipation. Author

N91-21649*# Northwest Analysis, Bozeman, MT.
THE GRAVITOMAGNETIC INTERACTION AND ITS RELATIONSHIP TO OTHER RELATIVISTIC GRAVITATIONAL EFFECTS Final Report, 1 Dec. 1990 - 30 Apr. 1991
Kenneth Nordtvedt Apr. 1991 54 p Submitted for publication
(NASA Order H-11215-D)
(NASA-CR-187736; NAS 1.26:187736) Avail: NTIS HC/MF A04 CSCL 08G

To better understand the relationship between the expected precession rates of an orbiting gyroscope (GP-B) and other observable consequences in the solar system of relativistic, post-Newtonian gravity, a phenomenological model was developed of post-Newtonian gravity which presupposes the very minimum possible concerning the nature and foundations of the gravitational interaction. Solar system observations, chiefly interplanetary ranging, fix all the parameters in the phenomenological model to various levels of precision. This permits prediction of gyroscope precession rates to better than 10 pct. accuracy. A number of new precession terms are calculated which would exist if gravity were not a metric field phenomenon, but this would clash with other empirical observations of post-Newtonian effects in gravity. It is shown that gravitomagnetism, the post-Newtonian gravitational corrections to the interactions between moving matter, plays a ubiquitous role in determining a wide variety of gravitational effects, including the precession of orbiting gyroscopes. Author

N91-21650# New England Research, Inc., White River Junction, VT.
PHYSICAL PROPERTY MEASUREMENTS ON ANALOG GRANITES RELATED TO THE JOINT VERIFICATION EXPERIMENT Technical Report, 15 May 1989 - 14 May 1990
Randolph J. Martin, III, Karl B. Coyner, and Robert W. Haupt 15 Aug. 1990 97 p
(Contract F19628-89-C-0097; ARPA Order 5307)
(AD-A230571; GL-TR-90-0171; SR-1) Avail: NTIS HC/MF A05 CSCL 08/7

A key element in JVE (Joint Verification Experiment) conducted jointly between the United States and the USSR is the analysis of the geology and physical properties of the rocks in the respective test sites. A study was initiated to examine unclassified crystalline rock specimens obtained from areas near the Soviet site, Semipalatinsk and appropriate analog samples selected from Mt. Katadin, Maine. These rocks were also compared to Sierra White and Westerly Granite which have been studied in great detail. Measurements performed to characterize these rocks were: (1) Uniaxial strain with simultaneous compressional and shear wave velocities; (2) Hydrostatic compression to 150 MPa with simultaneous compressional and shear wave velocities; (3) Attenuation measurements as a function of frequency and strain

amplitude for both dry and water saturated conditions. Elastic moduli determined from the hydrostatic compression and uniaxial strain test show that the rock matrix/mineral properties were comparable in magnitudes which vary within 25 percent from sample to sample. These properties appear to be approximately isotropic, especially at high pressures. However, anisotropy evident for certain samples at pressures below 35 MPa is attributed to dominant pre-existing microcrack populations and their alignments. Dependence of extensional attenuation and Young's modulus on strain amplitude were experimentally determined for intact Sierra White granite using the hysteresis loop technique. GRA

N91-21651# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

AUDIOMAGNETOTELLURIC (AMT) SOUNDINGS IN THE PROXIMITY OF THE CAMAQUA (RS) MINES [SONDAGENS AUDIOMAGNETOTELURICAS (AMT) NAS PROXIMIDADES DAS MINAS DE CAMAQUA (RS)]

Antonio Lopes Padilha, Icaro Vitorello, Nalin Babulal Trivedi, and Jose Marques daCosta Dec. 1990 32 p In PORTUGESE
(INPE-5213-RPE/641) Avail: NTIS HC/MF A03

Audiomagnetotelluric soundings were carried out in the region near Camaqua Mines (State of Rio Grande do Sul) with two distinct objectives: in the area of Rodeio Velho, corroborative evidences were sought for geological interpretation based on previous geomagnetic and gravity data; in Santa Maria, comparative soundings were planned between mineralized and non-mineralized areas. In Rodeio Velho, the soundings confirm sediment thicknesses of hundreds of meters, probably affected by vertical structures and the presence of alternating intercalated resistive and conductive layers. In the area of Santa Maria, the soundings in the mineralized areas present a more conducting intermediary layer which is approximately coincident with the position of the mineralized layer. Author

N91-21652# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

VARIABILITY OF THE Sq FOCUS POSITION IN THE SOUTH AMERICAN CONTINENT

R. P. Kane Nov. 1990 16 p Previously announced in IAA as A91-18696 Submitted for publication
(INPE-4740-PRE/1415) Avail: NTIS HC/MF A03

The daily variation of the H component at Pilar (31.7 S, 63.9 W) and Trelew (43.3 S, 65.3 W) in the South American continent indicates a great variability in amplitude from season to season and even from day to day. However, Pilar always remains equatorward of the southern Sq focus. On the other hand, Trelew is in most cases slightly poleward of th Sq focus; but the focus has large latitudinal excursions above and near Trelew. A cause of this variability could be the encroachment of polar ionospheric current systems into the low latitude ionospheric Sq current system. Author

N91-21653*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

GEODYNAMICS BRANCH DATA BASE FOR MAIN MAGNETIC FIELD ANALYSIS

Robert A. Langel and R. T. Baldwin (ST Systems Corp., Lanham, MD.) Apr. 1991 107 p
(NASA-TM-104542; Rept-91E01726; NAS 1.15:104542) Avail: NTIS HC/MF A06 CSCL 08G

The data sets used in geomagnetic field modeling at GSFC are described. Data are measured and obtained from a variety of information and sources. For clarity, data sets from different sources are categorized and processed separately. The data base is composed of magnetic observatory data, surface data, high quality aeromagnetic, high quality total intensity marine data, satellite data, and repeat data. These individual data categories are described in detail in a series of notebooks in the Geodynamics Branch, GSFC. This catalog reviews the original data sets, the processing history, and the final data sets available for each individual category of the data base and is to be used as a reference manual for the notebooks. Each data type used in geomagnetic field modeling has varying levels of complexity requiring specialized processing routines for satellite and observatory data and two general routines for processing aeromagnetic, marine, land survey, and repeat data. Author

N91-21654*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

GEOMAGNETIC MODEL INVESTIGATIONS FOR 1980 - 1989: A MODEL FOR STRATEGIC DEFENSE INITIATIVE PARTICLE BEAM EXPERIMENTS AND A STUDY IN THE EFFECTS OF DATA TYPES AND OBSERVATORY BIAS SOLUTIONS

Robert A. Langel, T. J. Sabaka, and R. T. Baldwin (ST Systems Corp., Lanham, MD.) Washington Apr. 1991 311 p
(NASA-TM-104541; Rept-91E01682; NAS 1.15:104541) Avail: NTIS HC/MF A14 CSCL 08G

Two suites of geomagnetic field models were generated at the request of Los Alamos National Lab. concerning Strategic Defense Initiative (SDI) research. The first is a progression of five models incorporating MAGSAT data and data from a sequence of batches as a priori information. The batch sequence is: post 1979.5 observatory data, post 1980 land survey and selected aeromagnetic and marine survey data, a special White Sands (NM) area survey by Project Magnet with some additional post 1980 marine survey data, and finally DE-2 satellite data. These models are of 13th deg and order in their main field terms, and deg and order 10 in their first derivative temporal terms. The second suite consists of four models based solely upon post 1983.5 observatory and survey data. They are of deg and order 10 in main field and 8 in a first deg Taylor series. A comprehensive error analysis was applied to both series, which accounted for error sources such as the truncated core and crustal fields, and the neglected Sq and low deg crustal fields. Comparison of the power spectrum of the MGST (10/81) model with those of this series show good agreement. Author

N91-21655# Fermi National Accelerator Lab., Batavia, IL.

CAN NON-GAUSSIAN FLUCTUATIONS FOR STRUCTURE FORMATION ARISE FROM INFLATION

D. S. Salopek Feb. 1991 9 p Presented at the NATO Advanced Research Workshop: Observational Tests of Inflation, Durham (UK), 10-14 Dec. 1990
(Contract DE-AC02-76CH-03000)
(DE91-009458; FNAL/C-91/53-A; CONF-901282-1) Avail: NTIS HC/MF A02

Non-Guassian fluctuation for structure formation may be generated during the inflationary epoch from the nonlinear interaction of two scalar fields with gravity. Semi-analytical calculations are given describing nonlinear long wavelength evolution in 3 + 1 dimensions. Long wavelength fields are governed by a single equation, the separated Hamilton-Jacobi equation (SHJE). Complete analytic solutions are discussed of the SHJE for two scalar fields with a potential whose logarithm 1n V (phi sub j) is linear. More complicated potential surfaces may be approximated by continuously joining various linear 1n V(phi sub j) potentials. Typically, non-Gaussian fluctuations arise when one passes over several sharp ridges in the potential surface. One can input this richer class of initial conditions into N-body codes to see the effects on the large scale structure in the Universe. The cleanest test of non-Gaussian fluctuations will hopefully occur in the near future from large angle microwave background anisotropy experiments. DOE

N91-21656# Lawrence Livermore National Lab., CA.

QUASILINEAR SIMULATION OF AURORAL KILOMETRIC RADIATION BY A RELATIVISTIC FOKKER-PLANCK CODE

Y. Matsuda 1991 5 p Presented at the 4th International School for Space Simulation, Nara (Japan), 1-5 Apr. 1991
(Contract W-7405-eng-48)
(DE91-009736; UCRL-JC-106422; CONF-9104109-2) Avail: NTIS HC/MF A01

An intense terrestrial radiation called the auroral kilometric radiation (AKR) is believed to be generated by cyclotron maser instability. We study a quasilinear evolution of this instability by

means of a two-dimensional relativistic Fokker-Planck code which treats waves and distributions self-consistently, including radiation loss and electron source and sink. We compare the distributions and wave amplitude with spacecraft observations to elucidate physical processes involved. DOE

N91-21657# University of South Florida, Saint Petersburg.
LARGE EDDY SIMULATION: WHERE DO WE STAND
1990 255 p Workshop held in St. Petersburg Beach, FL, 19-21 Dec. 1990
(Contract N00014-90-J-4120)
(AD-A230835) Avail: NTIS HC/MF A12 CSCL 20/4

These proceedings contain abstracts, extended abstracts and lectures presented at the International Workshop on Large Eddy Simulation. The presentations cover the major aspects of the theory of large eddy simulation and application of this technique to various complex engineering and geophysical flows. Session topics included: Turbulence theories, computational fluid dynamics, compressible flow, reacting flow, incompressible flow, atmospheric boundary layers, oceanic circulation, subgridscale parameterization, combustion, atmospheric physics, and physical oceanography. GRA

N91-21658# Boston Univ., MA. Center for Space Physics.
THE EFFECTS OF MAGNETIC STORM PHASES ON F-LAYER IRREGULARITIES FROM AURORAL TO EQUATORIAL LATITUDES Quarterly Report, 1 Oct. - 31 Dec. 1990
Jules Aarons and Michael Mendillo 31 Dec. 1990 4 p
(Contract N00014-89-J-1754)
(AD-A231373) Avail: NTIS HC/MF A01 CSCL 04/1

Some topics of discussion in this journal include the following: The effects of electric field and ring current energy increases on F-layer irregularities at auroral and sub-auroral latitudes; The role of the ring current in generating or inhibiting equatorial F-layer irregularities during magnetic storms; Auroral and sub-auroral F-layer irregularities and high plasma convection during the magnetically active periods of September 17-24, 1984; and Simultaneous All-Sky Optical Airglow Imaging Observations and San Marco Satellite Measurements in the Pacific Sector. GRA

N91-21659# Air Force Geophysics Lab., Hanscom AFB, MA.
POWER SPECTRA OF INTERNAL GRAVITY WAVES
E. M. Dewan 17 Sep. 1990 48 p
(AD-A231596; GL-TR-90-0233; GL-SR-265) Avail: NTIS HC/MF A03 CSCL 04/1

The OH layer located in the region of 85 km altitude emits strong infrared radiation. Gravity waves can be modulate the brightness of this layer over a wide range of spatial scales. Such fluctuations constitute, in effect, a form of IR clutter which could potentially degrade surveillance systems in certain situations. For this reason there is interest in the spatial and temporal variations of atmospheric internal gravity waves. A physical, similitude model of internal gravity waves assumes saturation of the waves and control by cascade processes of the temporal and horizontal scales of the waves. This model contains all the power spectral densities (PSD's) (sometimes merely called spectra) to be found in the formalism of Garrett and Munk. The latter is a purely empirical model for internal gravity waves applicable to the atmosphere and ocean. The main new predictions of the present model are that the dissipation rate controls the amplitudes of the frequency and horizontal wave number spectra. The validity of the proposed model is unknown at this time, and will depend upon the future experimental tests. It is shown, however, that based on 'typical' parametric values, results from the model are encouraging. GRA

N91-21660# Air Force Inst. of Tech., Wright-Patterson AFB, OH.
A SEARCH FOR EPISODIC INCREASES IN UPPER ATMOSPHERIC WATER VAPOR AS EVIDENCE OF AN EXTRATERRESTRIAL SOURCE M.S. Thesis
Michael F. Bonadonna May 1990 110 p
(AD-A231598; AFIT/CI/CIA-90-128) Avail: NTIS HC/MF A06 CSCL 04/1

This study examines the short-term variability of upper atmospheric water vapor with the intent of examining a proposed extraterrestrial water vapor source. This source would be provided by an influx of the small (12 m in. diameter) comets described by Frank et al. (1986). A ground-base microwave (22.235 GHz) radiometer located at Penn State has been measuring the thermal emission of upper atmospheric water vapor since 1984. Over 22,000 20-minute brightness temperature spectra from the period of Nov. 1984 through Dec. 1988 were analyzed for statistically significant, transient increases of the amounts of water vapor. This signature could indicate the presence of the cometary water vapor source. Individual 20-minute spectra were compared to the local 12-hour mean and variance spectra in a search for this excess signal signature or event. The analysis yielded 111 significant events which could have been caused by the cometary water vapor. The rate of detection (2.9 days between events) compares favorably with what could be expected from the small comet theory (1.8 days/events). This result is also comparable to the 4.1 days/events obtained by Adams (1988) using small subset of this data base. After exploring alternate explanations for the observed phenomena, it is concluded that these results support the existence of the small comet hypothesis. GRA

N91-21166# Norwegian Defence Research Establishment, Kjeller.
NORWEGIAN STUDIES OF PLASMA MODIFICATIONS AROUND SPACECRAFT AND HOW THESE AFFECT THE VEHICLE POTENTIAL
Bernt N. Maehlum *In* Norwegian Space Center, From Earth to Space and Back: Selected Papers on Norwegian Space Activities Mar. 1990 p 33-38 Previously announced in IAA as A90-26855 (For primary document see N91-21159 13-12)
Avail: NTIS HC/MF A04

N91-21167# Norwegian Space Center, Oslo.
SPACE RESEARCH IN NORWAY
B. N. Andersen *In its* From Earth to Space and Back: Selected Papers on Norwegian Space Activities Mar. 1990 p 39-48 Previously announced in IAA as A90-26856 (For primary document see N91-21159 13-12)
Avail: NTIS HC/MF A04

N91-21591*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
REPORT OF THE PANEL ON PLATE MOTION AND DEFORMATION, SECTION 2
Yehuda Bock, Kim A. Kastens, Marcia K. McNutt, J. Bernard Minster, Gilles Peltzer, William H. Prescott, Robert E. Reilinger, Leigh Royden, John B. Rundle (Sandia National Labs., Albuquerque, NM.), and Jeanne M. Sauber et al *In* National Aeronautics and Space Administration, Solid Earth Science in the 1990s. Volume 2: Panel Reports Feb. 1991 42 p (For primary document see N91-21590 13-42)
Avail: NTIS HC/MF A13 CSCL 08G

N91-21592*# Arizona Univ., Tucson.
REPORT OF THE PANEL ON LITHOSPHERIC STRUCTURE AND EVOLUTION, SECTION 3
Clement G. Chase, Harold Lang, Marcia K. McNutt, Earnest D. Paylor, David T. Sandwell, and Robert J. Stern (Texas Univ., Dallas.) *In* National Aeronautics and Space Administration, Solid Earth Science in the 1990s. Volume 2: Panel Reports Feb. 1991 25 p (For primary document see N91-21590 13-42)
Avail: NTIS HC/MF A13 CSCL 08G

N91-21593*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
REPORT OF THE PANEL ON VOLCANOLOGY, SECTION 4
Peter W. Francis, Peter Mouginis-Mark, David C. Pieri, William Rose, Stephen Self, and Charles A. Wood (National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.) *In* National Aeronautics and Space Administration,

Solid Earth Science in the 1990s. Volume 2: Panel Reports Feb. 1991 23 p (For primary document see N91-21590 13-42)
Avail: NTIS HC/MF A13 CSCL 08G

N91-21594*# Washington Univ., Seattle.
REPORT OF THE PANEL ON THE LAND SURFACE: PROCESS OF CHANGE, SECTION 5
John B. Adams, Eric E. Barron, Arthur A. Bloom, Carol Breed, J. Dohrenwend, Diane L. Evans, Thomas T. Farr, Allan R. Gillespie, B. L. Isaks, and Richard S. Williams (Geological Survey, Reston, VA.) *In* National Aeronautics and Space Administration, Solid Earth Science in the 1990s. Volume 2: Panel Reports Feb. 1991 27 p (For primary document see N91-21590 13-42)
Avail: NTIS HC/MF A13 CSCL 08G

N91-21595*# Harvard Univ., Cambridge, MA.
REPORT OF THE PANEL ON EARTH STRUCTURE AND DYNAMICS, SECTION 6
Adam M. Dziewonski, David C. McAdoo, Richard J. OConnell, Douglas E. Smylie, and Charles F. Yoder (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) *In* National Aeronautics and Space Administration, Solid Earth Science in the 1990s. Volume 2: Panel Reports Feb. 1991 26 p (For primary document see N91-21590 13-42)
Avail: NTIS HC/MF A13 CSCL 08G

N91-21596*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
REPORT OF THE PANEL ON EARTH ROTATION AND REFERENCE FRAMES, SECTION 7
Jean O. Dickey, Steven R. Dickman, Marshall T. Eubanks, Martine Feissel, Thomas A. Herring, Ivan I. Mueller, Richard D. Rosen, Robert E. Schutz, John M. Wahr, and Charles R. Wilson (Texas Univ., Austin.) *In* National Aeronautics and Space Administration, Solid Earth Science in the 1990s. Volume 2: Panel Reports Feb. 1991 22 p (For primary document see N91-21590 13-42)
Avail: NTIS HC/MF A13 CSCL 08G

N91-21597*# National Aeronautics and Space Administration, Washington, DC.
REPORT OF THE PANEL ON GEOPOTENTIAL FIELDS: GRAVITY FIELD, SECTION 8
Allen Joel Anderson, William M. Kaula, Andrew R. Lazarewics, Michel Lefebvre, Roger J. Phillips, Richard H. Rapp, Reinhard F. Rummel, David E. Smith, Byron D. Tapley, and Victor Zlotnick (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) *In its* Solid Earth Science in the 1990s. Volume 2: Panel Reports Feb. 1991 20 p (For primary document see N91-21590 13-42)
Avail: NTIS HC/MF A13 CSCL 08G

N91-21598*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
REPORT OF THE PANEL ON GEOPOTENTIAL FIELDS: MAGNETIC FIELD, SECTION 9
Jose J. Achache, George E. Backus, Edward R. Benton, Christopher G. A. Harrison (Miami Univ., Coral Gables, FL.), and Robert A. Langel *In* National Aeronautics and Space Administration, Solid Earth Science in the 1990s. Volume 2: Panel Reports Feb. 1991 35 p (For primary document see N91-21590 13-42)
Avail: NTIS HC/MF A13 CSCL 08G

47 METEOROLOGY AND CLIMATOLOGY

Includes weather forecasting and modification.

N91-21661*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
GEMPAK5 USER'S GUIDE, VERSION 5.0
Mary L. desJardins, Keith F. Brill, and Steven S. Schotz (General Sciences Corp., Lanham, MD.) Feb. 1991 221 p
(NASA-TM-4260; Rept-91B00036; NAS 1.15:4260) Avail: NTIS HC/MF A10 CSCL 04B

GEMPAK is a general meteorological software package used to analyze and display conventional meteorological data as well as satellite derived parameters. The User's Guide describes the GEMPAK5 programs and input parameters and details the algorithms used for the meteorological computations. Author

N91-21662*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
GEMPAK5. PART 1: GEMPAK5 PROGRAMMER'S GUIDE, VERSION 5.0
Mary L. desJardins, Keith F. Brill, and Steven S. Schotz (General Sciences Corp., Lanham, MD.) Feb. 1991 657 p
(NASA-TM-4261-Pt-1; NAS 1.15:4261-Pt-1) Avail: NTIS HC/MF A99 CSCL 04B

GEMPAK is a general meteorological software package used to analyze and display conventional meteorological data as well as satellite derived parameters. The Programmer's Guide describes the subroutines which can be used to build new GEMPAK programs. Part 1 contains GEMPAK subroutines. Author

N91-21663*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
GEMPAK5. PART 2: GEMPLT PROGRAMMER'S GUIDE, VERSION 5.0
Mary L. desJardins, Keith F. Brill, and Steven S. Schotz (General Sciences Corp., Lanham, MD.) Feb. 1991 126 p
(NASA-TM-4261-Pt-2; Rept-91B00038-Pt-2; NAS 1.15:4261-Pt-2)
Avail: NTIS HC/MF A07 CSCL 04B

GEMPAK is a general meteorological software package used to analyze and display conventional meteorological data as well as satellite derived parameters. The GEMPAK Programmer's Guide describes the subroutines which can be used in the GEMPAK graphics and transformation subsystem, GEMPLT. Author

N91-21664*# Washington Univ., Seattle. Dept. of Atmospheric Sciences.
ON THE RESPONSE OF THE SPECIAL SENSOR MICROWAVE/IMAGER TO THE MARINE ENVIRONMENT: IMPLICATIONS FOR ATMOSPHERIC PARAMETER RETRIEVALS Ph.D. Thesis
Grant W. Petty 1 Dec. 1990 305 p Original contains color illustrations
(Grant NAG5-943)
(NASA-CR-188032; NAS 1.26:188032) Avail: NTIS HC/MF A14; 1 functional color page CSCL 05B

A reasonably rigorous basis for understanding and extracting the physical information content of Special Sensor Microwave/Imager (SSM/I) satellite images of the marine environment is provided. To this end, a comprehensive algebraic parameterization is developed for the response of the SSM/I to a set of nine atmospheric and ocean surface parameters. The brightness temperature model includes a closed-form approximation to microwave radiative transfer in a non-scattering atmosphere and fitted models for surface emission and scattering based on geometric optics calculations for the roughened sea surface. The combined model is empirically tuned using suitable sets of SSM/I data and coincident surface observations. The brightness temperature model is then used to examine the sensitivity of the SSM/I to realistic variations in the scene being observed and to evaluate the theoretical maximum precision of global SSM/I retrievals of integrated water vapor, integrated cloud liquid water, and surface wind speed. A general minimum-variance method for optimally retrieving geophysical parameters from multichannel brightness temperature measurements is outlined, and several global statistical constraints of the type required by this method are computed. Finally, a unified set of efficient statistical and semi-physical algorithms is presented for obtaining fields of surface wind speed, integrated water vapor, cloud liquid water, and precipitation from SSM/I brightness temperature data. Features include: a semi-physical method for retrieving integrated cloud liquid water at 15 km resolution and with rms errors as small as approximately 0.02 kg/sq m; a 3-channel statistical algorithm for integrated water vapor which was constructed so as to have

improved linear response to water vapor and reduced sensitivity to precipitation; and two complementary indices of precipitation activity (based on 37 GHz attenuation and 85 GHz scattering, respectively), each of which are relatively insensitive to variations in other environmental parameters. Author

N91-21665*# Oklahoma Univ., Norman. School of Meteorology.

ESTIMATIONS OF ABL FLUXES AND OTHER TURBULENCE PARAMETERS FROM DOPPLER LIDAR DATA

Tzvi Gal-Chen, Mei Xu, and Wynn Eberhard (National Oceanic and Atmospheric Administration, Boulder, CO.) 1989 55 p (Grants NAG5-1379; NSF ATM-86-17735)

(NASA-CR-188053; NAS 1.26:188053) Avail: NTIS HC/MF A04 CSCL 04B

Techniques for extraction boundary layer parameters from measurements of a short-pulse CO2 Doppler lidar are described. The measurements are those collected during the First International Satellites Land Surface Climatology Project (ISLSCP) Field Experiment (FIFE). By continuously operating the lidar for about an hour, stable statistics of the radial velocities can be extracted. Assuming that the turbulence is horizontally homogeneous, the mean wind, its standard deviations, and the momentum fluxes were estimated. Spectral analysis of the radial velocities is also performed from which, by examining the amplitude of the power spectrum at the inertial range, the kinetic energy dissipation was deduced. Finally, using the statistical form of the Navier-Stokes equations, the surface heat flux is derived as the residual balance between the vertical gradient of the third moment of the vertical velocity and the kinetic energy dissipation. Combining many measurements would normally reduce the error provided that, it is unbiased and uncorrelated. The nature of some of the algorithms however, is such that, biased and correlated errors may be generated even though the raw measurements are not. Data processing procedures were developed that eliminate bias and minimize error correlation. Once bias and error correlations are accounted for, the large sample size is shown to reduce the errors substantially. The principal features of the derived turbulence statistics for two case studied are presented. Author

N91-21666# Cooperative Inst. for Research in the Atmosphere, Fort Collins, CO.

CASE STUDY ANALYSIS OF CLUSTERING APPLIED TO VAS MEASUREMENTS

D. W. Hillger, J. S. Snook, and J. F. W. Purdom 1990 8 p Presented at the 5th Satellite Meteorology and Oceanography Conference, London, England, 3-7 Sep. 1990 Sponsored by NOAA

(Contract NOAA-NA85RAH05045)

(PB91-127829) Avail: NTIS HC/MF A02 CSCL 04B

A joint effort is underway to test a technique for clustering satellite sounding measurements (Hillger and Purdom, 1990) that was developed at the Cooperative Institute for Research in the Atmosphere (CIRA) and applied to VISSR Atmospheric Sounder (VAS) data ingested at the Forecast Systems Laboratory (FSL). Clustering offers the advantage of increasing signal-to-noise by averaging measurements which are similar to within the noise levels of the VAS instrument. A case study day was chosen, which differs in two ways from previous tests of clustering on VAS. One difference was that measurements in selected VAS channels are not available for all horizontal scans of the satellite. The second difference was this case study included cloud-contaminated FOVs (Field of Views) along with clear FOVs. Findings from the study are the nearest to a real-time test that has been done. Results will define some of the advantages and disadvantages of clustering as compared to arbitrary blocking of VAS measurements which is presently used for operational satellite sounding production. GRA

N91-21667# National Oceanic and Atmospheric Administration, Silver Spring, MD. Air Resources Lab.

INTERCOMPARISON OF THE CHEMICAL AND METEOROLOGICAL DATA GENERATED FROM AIRCRAFT AND SHIPBOARD SAMPLING DURING GCE/CASE/WATOX

J. F. Boatman, W. C. Keene, M. Luria, J. D. Ray, and C. A. Bardwell Dec. 1990 31 p

(PB91-129098; NOAA-TM-ERL-ARL-186) Avail: NTIS HC/MF A03 CSCL 04B

Sixteen selected chemical and meteorological parameters from the NOAA ship Mt. Mitchell and the NOAA King Air research aircraft during the GCE/CASE (Coordinated Air Sea Experiment)/WATOX (Western Atlantic Ocean Experiment) experiment were compared. The aircraft made 8 research flights during Jul. 1988 in coordination with the ship. The first four were off the U.S. East Coast near Newport News, VA and the last four were near the island of Bermuda. Only the low altitude portions of the aircraft flights were used in the ship to aircraft intercomparisons. Generally, the aircraft and shipboard measurements were within expected accuracy limits. Selected exceptions for individual species and days are noted and discussed. GRA

N91-21668# National Weather Service, Salt Lake City, UT.

STRATUS SURGE PREDICTION ALONG THE CENTRAL CALIFORNIA COAST

P. Felsch and W. Whitlatch Dec. 1990 25 p Prepared in cooperation with San Jose State Univ., CA

(PB91-129239; NOAA-TM-NWS-WR-209) Avail: NTIS HC/MF A03 CSCL 04B

A stratus surge is defined as the apparent movement of a narrow band of stratus from south to north along the west coast of the United States. It is considered to be an anomalous mesoscale event during the summer season because macroscale winds are predominantly from the northwest. A simple forecast scheme to predict the initiation of stratus surges along the central California coast was developed and tested. The first part of the forecast scheme is based on a subjective screening of satellite images to determine the potential for a surge event. If that potential is high, an objective evaluation of the 850 mb Oakland RAOB temperature and San Francisco-Santa Maria sea level pressure difference is made to produce a final surge or no surge forecast. The forecast technique was developed using three years of data and tested independently on a fourth year. The subjective portion was effective in eliminating non-surge events. The objective portion resulted in skill scores of 0.48 for the development years and 0.56 for the test year. All data used to make the forecast are part of the incoming National Weather Service data stream. The technique is easy to apply and should serve as a basis for the development of similar methods for other locations along the coast. GRA

N91-21669# National Center for Atmospheric Research, Boulder, CO. Climate and Global Dynamics Div.

GLOBAL MONTHLY SEA SURFACE TEMPERATURE CLIMATOLOGY

D. J. Shea, K. E. Trenberth, and R. W. Reynolds Nov. 1990 169 p Prepared in cooperation with National Environmental Satellite Service, Washington, DC

(PB91-129304; NCAR/TN-345+STR) Avail: NTIS HC/MF A08 CSCL 04B

A new global 2 x 2 degree monthly sea surface temperature (SST) climatology, primarily derived from a 1950-1979 based SST climatology from the Climate Analysis Center (CAC), is presented and described. The purpose of developing this climatology is to provide a well documented and improved global SST climatology which can be used as a reference for defining SST anomalies, as a specified oceanic lower boundary condition in atmospheric general circulation models, and to validate ocean and coupled climate model simulations. The CAC climatology was modified by using data from the Comprehensive Ocean-Atmosphere Data Set (COADS) to improve the SST estimates in the regions of the Kuroshio and the Gulf Stream. The results are considerably larger and more realistic SST gradients in these regions. Some of the

mapped quantities presented in the atlas include: (1) the twelve monthly and annual mean SST fields; (2) SST differences between successive months; (3) monthly SST differences from the annual mean; (4) monthly SST differences from the zonal mean; (5) the amplitude, phase, and percent variance explained by the first three harmonics of the annual cycle; (6) monthly differences between the AM and STR SST climatologies; and (7) selected seasonal SST anomalies from 1982 to 1990. GRA

N91-21670*# Research and Data Systems, Inc., Greenbelt, MD.
ANALYSIS OF ERROR IN TOMS TOTAL OZONE AS A FUNCTION OF ORBIT AND ATTITUDE PARAMETERS
W. W. Gregg, P. E. Ardanuy, W. C. Braun, B. J. Vallette, P. K. Bhartia, and S. N. Ray (Software Corp. of America, Bowie, MD.) Washington Apr. 1991 44 p
(Contract NAS5-29373)
(NASA-CR-4361; Rept-91B00079; NAS 1.26:4361) Avail: NTIS HC/MF A03 CSCL 04B

Computer simulations of orbital scenarios were performed to examine the effects of orbital altitude, equator crossing time, attitude uncertainty, and orbital eccentricity on ozone observations by future satellites. These effects were assessed by determining changes in solar and viewing geometry and earth daytime coverage loss. The importance of these changes on ozone retrieval was determined by simulating uncertainties in the TOMS ozone retrieval algorithm. The major findings are as follows: (1) Drift of equator crossing time from local noon would have the largest effect on the quality of ozone derived from TOMS. The most significant effect of this drift is the loss of earth daytime coverage in the winter hemisphere. The loss in coverage increases from 1 degree latitude for + or - 1 hour from noon, 6 degrees for + or - 3 hours from noon, to 53 degrees for + or - 6 hours from noon. An additional effect is the increase in ozone retrieval errors due to high solar zenith angles. (2) To maintain contiguous earth coverage, the maximum scan angle of the sensor must be increased with decreasing orbital altitude. The maximum scan angle required for full coverage at the equator varies from 60 degrees at 600 km altitude to 45 degrees at 1200 km. This produces an increase in spacecraft zenith angle, theta, which decreases the ozone retrieval accuracy. The range in theta was approximately 72 degrees for 600 km to approximately 57 degrees at 1200 km. (3) The effect of elliptical orbits is to create gaps in coverage along the subsatellite track. An elliptical orbit with a 200 km perigee and 1200 km apogee produced a maximum earth coverage gap of about 45 km at the perigee at nadir. (4) An attitude uncertainty of 0.1 degree in each axis (pitch, roll, yaw) produced a maximum scan angle to view the pole, and maximum solar zenith angle). Author

N91-21671# National Severe Storms Lab., Norman, OK.
GUST FRONT/WIND SHIFT DETECTION ALGORITHM FOR THE TERMINAL DOPPLER WEATHER RADAR Final Report
Arthur Witt, Steven D. Smith, Michael D. Eilts, Laurie G. Hermes, and Diana L. Klingle-Wilson (Massachusetts Inst. of Tech., Lexington.) Nov. 1989 74 p
(Contract DTFA01-80-Y-10524)
(DOT/FAA/NR-91/4) Avail: NTIS HC/MF A04

An algorithm for real-time detection of tornadoes, using single-Doppler radar data is described. This algorithm searches for tornadic vortex signatures (TVS's) which are characterized by strong azimuthal radial velocity differences, above a certain threshold, between adjacent gates at constant range. It then builds these pattern vectors into features for each scan in elevation, and finally determines the vertical correlation among features. When at least three features are vertically correlated and the lowest one is below a prescribed minimum height threshold, a TVS is declared, indicating that a tornado is occurring. If the lowest feature is not below the height threshold, a potential TVS is declared, indicating that a tornado may soon occur. Author

N91-21672# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
STATISTICAL FORECASTING OF PRECIPITATION ASSOCIATED WITH THE PASSAGE OF FRONTAL SYSTEMS IN THE SOUTH REGION OF BRAZIL M.S. Thesis [PREVISAO ESTATISTICA DE PRECIPITACAO ASSOCIADA A PASSAGEM DE SISTEMAS FRONTAIS NA REGIAO SUL DO BRASIL]
Emma Giada Matschinske Dec. 1990 110 p In PORTUGUESE; ENGLISH summary
(INPE-5208-TDL/429) Avail: NTIS HC/MF A06

Quantitative precipitation forecasting associated with frontal passages over Rio Grande do Sul (RS) is attempted. For this purpose, multiple linear regression models expressing the precipitation in terms of meteorological parameters related to fronts are constructed. Synoptic and upper air charts of the three year period 1986 to 1988 are examined to identify the frontal system passages over RS, and the meteorological data for the episodes are collected. Author

N91-21673*# California Univ., Los Angeles.
NORTH ATLANTIC WEATHER REGIMES: A SYNOPTIC STUDY OF PHASE SPACE M.S. Thesis
Anna Karin Orrhede 1990 8 p
(Grants NAG5-713; NSF ATM-86-15424)
(NASA-CR-188162; NAS 1.26:188162) Avail: NTIS HC/MF A02 CSCL 04B

In the phase space of weather, low frequency variability (LFV) of the atmosphere can be captured in a large scale subspace, where a trajectory connects consecutive large scale weather maps, thus revealing flow changes and recurrences. Using this approach, Vautard applied the trajectory speed minimization method (Vautard and Legras) to atmospheric data. From 37 winters of 700 mb geopotential height anomalies over the North Atlantic and the adjacent land masses, four persistent and recurrent weather patterns, interpreted as weather regimes, were discernable: a blocking regime, a zonal regime, a Greenland anticyclone regime, and an Atlantic regime. These regimes are studied further in terms of maintenance and transitions. A regime survey unveils preferences regarding event durations and precursors for the onset or break of an event. The transition frequencies between regimes vary, and together with the transition times, suggest the existence of easier transition routes. These matters are more systematically studied using complete synoptic map sequences from a number of events. Author

N91-21674# California Univ., Los Angeles.
NONLINEAR SYMMETRIC INSTABILITY AND OSCILLATIONS IN THE TROPICAL ATMOSPHERE M.S. Thesis Abstract Only
Jingxia Zhao 1990 5 p
Avail: NTIS HC/MF A01

Symmetric inertial instability (SII) is studied as a mechanism for stratospheric and tropospheric phenomena in the equatorial regions. The linear and nonlinear dynamics of SII was investigated in a two-layer zonally-symmetric model on an equatorial beta-plane, in the presence of a basic flow with horizontal and vertical shear, with and without dissipative effects. Linear symmetric instabilities are, in accordance with previously published results, purely exponential, i.e., nonoscillatory. Nonlinear SII can produce finite amplitude oscillatory behavior, periodic or chaotic. The period of the oscillations in the inviscid case depends on the initial data. In the presence of dissipative effects, all solutions tend to a limit cycle or to a strange attractor. The dominant period in this case, over a wide range of parameters and whether vertical shear is present or not, is close to 40-50 days. It appears therefore that these oscillations might be related to well known low-frequency oscillations in the tropical atmosphere. Author

N91-21675# Naval Oceanographic and Atmospheric Research Lab., Bay Saint Louis, MS.
TROPICAL CYCLONE TRACK OBJECTIVE AIDS FOR THE MICROCOMPUTER: PCLM, XTRP, PCHP Final Report
C. R. Sampson, R. J. Miller, R. A. Kreitner, and T. L. Tsui Aug.

1990 20 p
(AD-A230851; NOARL-TN-61) Avail: NTIS HC/MF A03 CSCL 04/2

A Climatology Objective Aid for the microcomputer has been developed which includes a forecast based on climatology (PCLM), a persistence forecast (XTRP), and a half persistence and climatology forecast (PCHP). The climatology is 1945-89 data from the western North Pacific, eastern North Pacific, South Pacific and Indian Oceans. The objectives aid has a graphical presentation of the climatological tracks used in the forecast. Results from homogeneous comparisons of forecast errors from the first 18 storms in the western North Pacific during 1989 show that PCLM functions adequately. GRA

N91-21676# Naval Environmental Prediction Research Facility, Monterey, CA.
SATELLITE CLOUD ANALYSES: A NOWCASTING CAPABILITY FOR THE US NAVY'S TESS(3)
C. Crosiar, K. Richardson, and G. Haugen 1990 3 p
(AD-A231120; NEPRF-PR-90-050-431) Avail: NTIS HC/MF A01 CSCL 04/2

The tactical Environmental Support System, third generation, TESS(3), is the U.S. Navy's newly developed computer workstation for both ashore and afloat sites. The TESS(3) computer system is interfaced to the Navy's Antenna Meteorological Data Receiver-Recorder, AN/SMQ-11. The SMQ-11 acquires satellite data from the Defense Meteorological Satellite Program (DMSP) and the National Oceanic and Atmospheric (NOAA) polar orbiting satellites. Weather facsimile (WEFAX) transmissions from the Geostationary Operational Environmental Satellite (GOES) are also received with the SMQ-11. TESS(3) has two disks dedicated to satellite data in contiguous format for real time data acquisition. Each 384MB disk is capable of storing 1 DMSP, 1 NOAA, 1 DMSP or NOAA 14 minute pass and 4 four minute WEFAX transmissions. In addition, the special sensor data, such as the Special Sensor Microwave/Imager (SSM/I) and the TIROS Operational Vertical Sounder (TOVS), are stored on these satellite data disks. GRA

N91-21677# Naval Environmental Prediction Research Facility, Monterey, CA.
THE OCEANIC CLOUDY ATMOSPHERE: MEASUREMENT REQUIREMENTS AND SOLUTION OPTIONS
Duncan B. Ross and Richard A. Siquig 1990 16 p
(AD-A231121; NEPRF-PR-90-016-442) Avail: NTIS HC/MF A03 CSCL 04/2

The cloudy oceanic atmosphere influences warfare in many ways. This paper presents the results of a quantitative evaluation of the effects of clouds and other atmospheric parameters on naval warfare areas and considers the use of a microwave system as deployed from airborne platforms to measure the desired parameters. The quantitative analysis scheme consists of development of a matrix with rows of cloud and other atmospheric parameters and columns of naval warfare areas. The study required development of an appropriate list of environmental parameters and a knowledge of the accuracy and resolution to which each parameter should be known. All warfare areas were found to be significantly influenced by at least some atmospheric phenomena, with anti-air, anti-surface ship, and strike warfare being the most sensitive. Measurement of cloud cover in an ocean environment can only be accomplished by a combination of surface, airborne, and satellite remote sensors. Both active and passive microwave systems are discussed. GRA

N91-21678# Scripps Institution of Oceanography, La Jolla, CA. Marine Physical Lab.
PROBABILITY ESTIMATES OF CLOUD-OBSCURED LINE-OF-SIGHT
Wayne S. Hering 30 May 1990 12 p
(Contract F19628-88-K-0005)
(AD-A231151; SIO-REF-90-28; MPL-U-46/91) Avail: NTIS HC/MF A03 CSCL 17/5

The purpose of this study is to explore the basic relationships between the climatic frequency distribution of sky cover and the frequency and duration of Cloudy-Lines-of-Sight (CLOS) from one or more ground sites to points in space. Through a series of model calculations, estimates are made of the incremental changes in CLOS persistence and recurrence that correspond to changes in the climatic frequency of overcast, broken, scattered and clear sky conditions. The determination of CLOS recurrence and persistence probability were made using the bivariate normal distribution. The analytical stochastic model is based upon the Ornstein-Uhlenbeck class of the simple Markov process. A discussion of the procedures for modeling CLOS behavior is given in a previous report. Model results are presented for CLOS as a function of sky cover and path sight, CLOS recurrence and persistence probability relative to fixed categories of sky cover, and both single and multiple site CLOS recurrence and persistence probability relative to fixed categories of sky cover, and both single and multiple site CLOS recurrence and persistence probabilities. GRA

N91-21679# Naval Postgraduate School, Monterey, CA.
ONR TROPICAL CYCLONE MOTION RESEARCH INITIATIVE: FIELD EXPERIMENT SUMMARY Interim Report, Oct. 1989 - Sep. 1990
Russell L. Elsberry, B. C. Diehl, J. C.-L. Chan, P. A. Harr, and G. J. Holland Nov. 1990 116 p
(AD-A231152; NPS-MR-91-001) Avail: NTIS HC/MF A06 CSCL 04/2

The Tropical Cyclone Motion initiative is a five-year program to improve basic understanding of tropical cyclone motion. The Tropical Cyclone Motion (TCM-90) field experiment was carried out during August and September 1990. The first section of this report describes the data management plan for TCM-90, and includes descriptions of the observational systems that provided data in real-time and on a delayed basis. The second section of this report summarizes the seven Intensive Observation Periods during TCM-90. A summary of the real-time data collection also is provided to aid the reader in selecting cases for study. A more complete listing that includes delayed data will be provided about April 1991, when the production of the final analyses will begin. GRA

N91-21680# Naval Environmental Prediction Research Facility, Monterey, CA.
CLOUD CLASSIFICATION OF DMSP VISIBLE AND IR IMAGERY USING PHYSICAL AND TEXTURAL FEATURES
Andreas K. Goroch and R. N. Welch 1990 7 p
(AD-A231186) Avail: NTIS HC/MF A02 CSCL 04/2

Cloud features have an important impact on global Navy activities, ranging from the effects of clouds on surface ship and aircraft operations to the limitation and enhancement of surveillance activities. An automated system is being developed for the recognition of operationally important cloud types using data obtained from the Defence Meteorological Satellite Program (DMSP) satellite system. The satellite is deployed in a sun-synchronous morning orbit, and carries a variety of sensors, including the Optical Line Scanner (OLS). Ongoing work in the use of physical and textural measures for the automatic recognition of cloud class is described. The physical measures were found to be relatively computer intensive, and dependent on visible and IR satellite data. The addition of textural measures shows promise for enhancing the classification capability by using only a single channel and by reducing computer processing time. GRA

N91-21681# Naval Oceanographic and Atmospheric Research Lab., Monterey, CA.
TACTICAL ENVIRONMENTAL SUPPORT SYSTEM (TESS(3)) SATELLITE CLOUD ANALYSES Proceedings Report
C. Crosiar, K. Richardson, and G. Haugen 1990 6 p
(AD-A231247; NOARL-PR-90-066-431) Avail: NTIS HC/MF A02 CSCL 04/2

The United States Navy is developing a computer workstation capable of ingesting real time satellite data, called the Tactical Environmental Support System, third generation, or TESS(3). This

computer is expected to reside at both ashore and afloat sites. One of the main functions of TESS(3) is to process digital satellite data from the NOAA and DMSP satellites. The baseline processing include the automated scheduling, ingest, navigation and display of the imagery. The Naval Oceanographic and Atmospheric Laboratory (NOARL) is augmenting the capability with cloud analysis software that is capable of detailed cloud analysis and classification. GRA

N91-21682# Battelle Memorial Inst., Columbus, OH.
EXPERIMENT ON RAPIDLY INTENSIFYING CYCLONES OVER THE ATLANTIC Final Report
Dec. 1990 44 p
(Contract N00014-85-C-0518)
(AD-A231377) Avail: NTIS HC/MF A03 CSCL 04/2

The Experiment on Rapidly Intensifying Cyclones over the Atlantic (ERICA) field study is designed to determine physical mechanisms and processes, and their critical spatial and temporal combinations, which can account for the wintertime phenomenon of explosively-developing over-ocean atmospheric storms. The core field experiment will be supplemented by the substantial participation of many other agencies and universities from the United States and Canada. Data will be obtained over the North Atlantic Ocean from Cape Hatteras to beyond Newfoundland, centered east of Cape Cod and south of Nova Scotia. The general timing and siting is chosen through consideration of historical storm occurrence data. Measurements on individual rapidly intensifying storms will be made from aircraft, buoys, and satellites, and by soundings and radars. Observations made during the pre-ERICA field test, January 1988, are discussed. The measurement objectives and the ways by which the field data will be collected are described. GRA

N91-21683# Air Weather Service, Scott AFB, IL.
CONVECTIVE SCALE DYNAMICS
Jeffrey R. Hedges Dec. 1990 41 p
(AD-A231567; AWS/TR-90/001) Avail: NTIS HC/MF A03 CSCL 04/2

A simplified discussion is presented of the convective process, the thunderstorm, and severe weather. Explanations of stability and the parcel theory are included. Thunderstorms, from garden variety to supercell are described. How to recognize and forecast severe weather is explained. GRA

N91-21684# Air Force Inst. of Tech., Wright-Patterson AFB, OH.
FEATURES OF THE RALEIGH TORNADIC STORM BASED ON ANALYSIS OF DAMAGE M.S. Thesis
John T. Roth 1990 125 p
(AD-A231601; AFIT/CI/CIA-90-145) Avail: NTIS HC/MF A06 CSCL 04/2

A computer model was devised to simulate damage patterns caused by a tornado. Results from this model were examined and compared to the actual damage. By manipulating the input values so the output graphs look similar to the actual damage, the magnitude and direction of the ambient wind, and the location of microbursts, could be estimated. The results suggest the tornado was accompanied by ambient winds of at least 20 m/s, and microbursts in all quadrants relative to the tornado motion except the left front quadrant. The results, as well as the distribution of the damage itself, suggest that the intensity of the damage was increased by the presence of microbursts interacting with the tornado. GRA

48 OCEANOGRAPHY

Includes biological, dynamic, and physical oceanography; and marine resources.

For related information see also *43 Earth Resources and Remote Sensing.*

N91-21685# National Oceanic and Atmospheric Administration, Miami, FL. Oceanographic and Meteorological Lab.
CURRENT VELOCITY AND HYDROGRAPHIC OBSERVATIONS IN THE SOUTHWESTERN NORTH ATLANTIC OCEAN: SUBTROPICAL ATLANTIC CLIMATE STUDIES (STACS), 1989
Anne Marie Wilburn, Elizabeth Johns, and Mark Bushnell Oct. 1990 100 p
(PB91-115535; NOAA-DR-ERL-AOML-18) Avail: NTIS HC/MF A05 CSCL 08C

The primary objectives of the Subtropical Atlantic Climate Studies (STACS) program are to increase the understanding of the dynamics of the North Atlantic circulation and the role of ocean circulation in global climate, to develop the capability to monitor the climatically important processes, and to provide data needed in the development of the coupled ocean-atmosphere general circulation models to be used for global climate prediction. In particular, the mechanisms by which the ocean transports heat to balance the net radiation deficit at northerly latitudes are being studied. The initial objectives of STACS were directed at the Florida Current, a flow which makes significant contribution to heat flux. After an intensive two-year observing program, the capability to monitor the Florida Current transport without extensive ship-board observations, was obtained. Data from STACS cruises conducted on the NOAA ships Albatross 4 and Malcolm Baldrige during two cruises (Feb. and Aug. 1989) are contained. Author

N91-21686# Old Dominion Univ., Norfolk, VA.
WINTER 1990 HYDROGRAPHICS DATA REPORT: CTD STATION PROFILES, SECTIONS, NUTRIENTS, SAIL, JANUARY - FEBRUARY 1990
W. S. Chandler and L. P. Atkinson Jan. 1991 255 p
(Contract DE-FG05-85ER-60348)
(DE91-008286; DOE/ER-60348/T2; TR-91-2) Avail: NTIS HC/MF A12

The WINTER 1990 Hydrographic Data Report includes conductivity, temperature, and depth CTD data listings and profile plots of each station taken aboard the R/V Cape Hatteras from 27 Jan. to 9 Feb. 1990. This report also contains vertical section contour plots, time series contour plots, nutrient, chlorophyll, and Shipboard Serial Ascii Instrumentation Loop (SAIL) data. The Winter 1990 cruise further tested our ideas of shelf break processes. These ideas were based on the GALE observations in January 1986. During those observations we discovered that intense southward winds and heat loss caused onshore flow of nutrients and enhanced production. GALE was primarily a meteorological and oceanographic study with limited biological observations. Winter 1990 repeated the GALE experiment with added chemical and biological measurements. DOE

N91-21687# California Univ., Los Angeles.
DATA ASSIMILATION AND WIND-STRESS ERROR CORRECTION IN A FORCED TROPICAL OCEAN MODEL M.S. Thesis Abstract Only
Hao Zheng 1991 5 p
Avail: NTIS HC/MF A01

A major error source in numerical simulations of tropical oceans is the uncertainty in wind stress. Assimilation of ocean data is used to correct this simulation error. The model used is governed by the reduced gravity shallow water equations modified by the long wave approximation, within a rectangular basin symmetric about the Equator. All experiments are of the 'identical twin' type: the observations are generated by sampling the desired reference solution, and the data are assimilated by optimal interpolation (OI) into the same model, with wind stress forcing different from that in the reference case. The effect of the Kelvin wave and Rossby waves excited by the updating of observations is assessed by examining the performance of the assimilation runs with data

projected onto these waves. When both thermocline depth and zonal velocity at all gridpoints are observed, data assimilation compensates for the wind stress errors. The relative importance of the information in Kelvin and Rossby waves depends on where the wind stress error occurs: when the error is over the western part of the basin, the Kelvin waves play an important role in the assimilation; for wind stress errors over the eastern part, the Rossby waves are important. Author

N91-21688# Naval Underwater Systems Center, Newport, RI.
STATISTICAL PROPERTIES OF THE SEA SURFACE SOUND DIPOLE SOURCE
R. M. Kennedy Dec. 1990 27 p Presented at the 120th Meeting of the Acoustical Society of America, San Diego, CA, Dec. 1990
(AD-A230811; NUSC-TD-88-03) Avail: NTIS HC/MF A03 CSCL 20/1

A broadband measurement (40 to 4000 Hz) of the vertical directional spectrum of the underwater ambient acoustic filed was made in an acoustically isolated area where the ambient is dominated by well documented local sea conditions. Measurements, made over a one-year period, sampled a wide range of sea conditions and made possible a statistical analysis of the effects of the sea surface condition on the acoustic field. Having the total directional spectrum, unperturbed by long-distance sources, allowed the partitioning of the measurement into multiple source types; each type distinguished by its unique vertical directional pattern. An important component of the sea surface-generated radiation is a diffuse distribution of vertical dipole sources. A unique property of this data analysis is that the dipole source strength 'area density' is found by matching only that part of the total measured pressure field exhibiting a dipole pattern. This is accomplished by parametric spectral estimation procedures. The frequency spectrum of the dipole source strength is found to be a bandpass function whose parameters are statistically related to the wind-generated surface friction velocity. Results of the analysis contribute an important element to an accurate modeling of the space-time statistics of sea surface sound. GRA

N91-21689# Naval Oceanographic and Atmospheric Research Lab., Bay Saint Louis, MS.
IMPLEMENTATION OF AN OCEANOGRAPHIC EXPERT SYSTEM: PROBLEMS, FEEDBACK, SOLUTIONS Proceedings Report
Robert S. Romalewski and Matthew Lybanon Apr. 1990 6 p
(AD-A230886; NOARL-PR-89-069-252) Avail: NTIS HC/MF A02 CSCL 12/5

An oceanographic expert system to describe the evolution of the Gulf Stream and its rings was developed at NOARL. The latest results show the expert system to be more than 60 percent accurate in ring location predictions. The structural composition of the implemented expert system consists of an OPS83 rule based shell and modules, using primarily C for algorithms. Past funding and time allocation decisions affected design and software construction, in turn significantly impacting the project. Some of the computer related problems encountered during the drive to obtain a production version for the oceanographic analyst are described. GRA

N91-21690# Pacific Missile Test Center, Point Mugu, CA.
SATELLITE-DERIVED MOISTURE-BOGUSING PROFILES FOR THE NORTHWEST PACIFIC OCEAN
L. W. Eddington Aug. 1990 30 p
(AD-A231058; NOARL-TN-58) Avail: NTIS HC/MF A03 CSCL 04/2

Since the early 1970's the National Meteorological Center has attempted to improve its initialization of moisture in numerical weather prediction models by using a technique called moisture bogusing. The technique involves including pre-computed vertical profiles of relative humidity in model initialization over ocean areas normally devoid of in situ observations. Each moisture profile is intended to be representative of a particular meteorological condition identifiable by subjective satellite image analysis. This report represents a set of 12 vertical profiles of relative humidity versus barometric pressure for use in satellite bogusing of moisture into numerical weather prediction initial analysis for the Northwest Pacific Ocean region. The profiles are based on a subjective satellite image cloud classification scheme applied to a concurrent set of satellite images and upper-air soundings taken from ships. Vertical relative humidity profile composites and statistical significance tests are presented for each category. GRA

N91-21691# Naval Oceanographic and Atmospheric Research Lab., Bay Saint Louis, MS.
SATELLITE ALTIMETRY FOR NAVAL OCEANOGRAPHY Final Report
D. R. Johnson Nov. 1990 108 p
(AD-A231081; NOARL-TN-87) Avail: NTIS HC/MF A06 CSCL 08/3

New approaches to satellite altimetry will be needed to meet future naval tactical and strategic performance goals. This report considers advanced sampling strategies and increased measurement accuracies that will lead to improved operational geophysical products. Taking advantage of experience gained during the flight of the U.S. Navy's GEOSAT altimeter, this note discusses some of the problems encountered and recommends new approaches for future altimeter systems. In particular, the author strongly urges that exact-repeat track sampling be continued for the next decade. Optimum sampling for mesoscale features can be realistically accomplished with three altimeters flying at 7-day refresh periods with equidistant crosstrack spacing. More formal recommendations will come with the results of current studies using various configurations during mission simulations. It is also recommended that additional effort be invested in sea ice monitoring and in geophysical corrections. GRA

N91-21692# Scripps Institution of Oceanography, La Jolla, CA. Marine Physical Lab.
A 200 Hz MATCHED FIELD PROCESSING ON THE SEPTEMBER 1987 VLA DATA SET
Jean-Marie Q. Tran and William S. Hodgkiss Sep. 1990 83 p
(Contract N00014-89-K-0038)
(AD-A231096; MPL-TM-417; MPL-U-6/90) Avail: NTIS HC/MF A05 CSCL 17/1

This technical report demonstrates, based on data collected at sea during the September 1987 Vertical Line Array (VLA) Experiment in the North-East Pacific, that matched field processing is a viable processing technique at 200 Hz and on a 900 m long vertical line array. The sound speed information derived from the CTD and XBT data collected during the experiment allows a good acoustic modeling by the ATLAS normal mode model of the CW transmissions. Although mismatch still exists, matched field processing produces good estimates of the source ranges for both fixed station transmissions. Source depth estimation appears, in this data set, a more difficult problem. The VLA system has acoustic navigation capabilities which show that the array, generally, has a tilt on the order of 1 deg. This tilt corresponds to a 15 m horizontal displacement from the top to the bottom of the array or two wavelengths at 200 Hz. Simulations indicate that array tilt can result in large losses and significant pattern changes in the range-depth ambiguity surfaces and is the main source of mismatch. GRA

N91-21693# Harvard Univ., Cambridge, MA. Div. of Applied Sciences.
DYNAMICS OF OCEANIC MOTIONS Final Report, 1 Jan. 1975 - 29 Feb. 1984
Allan R. Robinson 26 Dec. 1990 8 p
(Contract N00014-75-C-0225)
(AD-A231135) Avail: NTIS HC/MF A02 CSCL 08/3

This project researched the dynamics of oceanic motions: aspects of the theory and modeling of fundamental dynamics and energetic processes in the sea and their interactions, and the relationship of theory and modeling to the interpretation, analysis and design of observational data and experiments. Research was directed towards the dynamics and the forecasting of the low

frequency variability of ocean currents (mid-ocean eddies and intense current systems), the mid-latitude general circulation, and surface boundary and internal wave layer interactions. Our modeling research was directed toward studies of the local dynamics of open regions of the ocean (i.e., arbitrary regions with flow across their boundaries), and the relationship of such regional dynamics to the larger scale general circulation in which it is embedded. The approach was adopted as appropriate for application to intensive local data sets and for the development and testing of forecast methods for oceanic synoptic/mesoscale motions. This report consists primarily of a listing of the 48 referred publications and 22 additional technical reports produced under this project. GRA

N91-21694# Scripps Institution of Oceanography, La Jolla, CA. Marine Physical Lab.

INTERACTION OF SURFACE WAVES AND NEAR SURFACE CURRENTS Final Report

Jerome A. Smith Jan. 1991 6 p

(Contract N00014-89-J-1154)

(AD-A231612; MPL-U-2/91) Avail: NTIS HC/MF A02 CSCL 08/3

Wind waves on the sea surface are modulated by both longer waves (e.g., swell) and by low frequency motion such a Langmuir circulation or internal waves. The modulation of the small wind wave components helps to make the lower frequency activity 'visible,' both with optical and radar techniques. Conversely, interaction with the larger wind waves can be important to the formation and growth of the low frequency motion. The growth and dissipation of the surfaces waves are also important in this interaction. The ultimate goal is to understand the physical mechanisms behind observed modulations of ocean surface wind waves. Proper interpretation of remotely sensed images require a thorough understanding of the behavior of the short scattering waves. Estimates of air-sea fluxes of gases, heat, momentum, etc. are also strongly dependent on the details of the wave modulation and breaking both directly and via induced secondary flows such as Langmuir circulation. This project addressed two problems within this context: (1) modulation of short waves by longer ones, in the presence of both strong generation and dissipation; and (2) interaction of surface waves and Langmuir circulation, with special attention towards identifying an observable effect on the waves. GRA

N91-21695# Naval Oceanographic and Atmospheric Research Lab., Bay Saint Louis, MS.

OBJECTIVE USE OF SATELLITE ALTIMETRY AND IR IN SIMULATIONS OF WESTERN BOUNDARY CURRENT DYNAMICS

Dantel N. Fox, Michael R. Cauocs, and Jim L. Mitchell 1990 7 p

(AD-A231628; NOARL-PR-90-064-323) Avail: NTIS HC/MF A02 CSCL 08/3

A series of numerical experiments to predict the evolution of the Gulf Stream have been performed. The forecast system uses a primitive equation model of the north western Atlantic Ocean and assimulation schemes which employ both a feature model and statistical correlations derived from the regional climatology of in-situ data and long time-base numerical simulations. The evaluation criterion is the mean absolute distance between forecast locations of the Gulf Stream front and actual locations as verified from extensive satellite and in situ data. Eight one-week and five two-week evaluation intervals during 1986 to 1988 were selected to represent a variety of both active and inactive Gulf Stream regimes. To insure objectivity, hindcasting was disallowed. The resulting forecasts were significantly better than persistence at both one- and two-week intervals. This study indicates the feasibility of Gulf Stream forecasting using assimulation schemes which provide adequate deep information and numerical models which are designed to be consistent with available data. GRA

51 LIFE SCIENCES (GENERAL)

N91-21696*# National Aeronautics and Space Administration, Washington, DC.

EXPLORING THE LIVING UNIVERSE: A STRATEGY FOR SPACE LIFE SCIENCES

Jun. 1988 21 p Original contains color illustrations

(NASA-TM-103399; NAS 1.15:103399) Avail: NTIS HC/MF A03; 2 functional color pages CSCL 06C

The knowledge obtained by space life sciences will play a pivotal role as humankind reaches out to explore the solar system. Information is needed concerning the existence of life beyond the Earth, the potential interactions between planets and living organisms, and the possibilities for humans to inhabit space safely and productively. Programs in the involved disciplines are an integral part of NASA's current and future missions. To realize their objectives, the development and operation of diverse ground and flight facilities and clost coordination with numerous scientific and governmental organizations in the U.S. and abroad are required. The status and goals of the life sciences programs are examined. Ways and means for attaining these goals are suggested. B.G.

N91-21697# National Academy of Sciences - National Research Council, Washington, DC. Committee on the Use of Animals in Research.

SCIENCE, MEDICINE AND ANIMALS

John E. Burris and Steve Olson, ed. 1991 41 p

(ISBN-0-309-04439-1; LC-90-27785) Avail: NTIS HC/MF A03

The history, status, and potential of animal research is described in the hopes of providing the information which will allow people to judge the merit and necessity for continuing animal research. The use of animals in research; advances as a result of animal experimentation; benefits to animals from animal research; alternatives; animal rights; laws and regulations; pain and suffering; use of pound animals; and the cost to society of the Animal Rights Movement are briefly covered. B.G.

N91-21698# Arizona State Univ., Tempe. Dept. of Chemistry.

A CENTER FOR THE STUDY OF EARLY EVENTS IN PHOTOSYNTHESIS

1991 23 p

(Contract DE-FG02-88ER-13969)

(DE91-008509; DOE/ER-13969/T1) Avail: NTIS HC/MF A03

The first 2 1/2 years of the Center have been very productive. Research completed by Center scientists has resulted in publication or acceptance of 60 papers, with several more currently under consideration. Individual project summaries are as follows: J. P. Allen is investigation molecular mechanisms of the reaction center, and influence of protein structure on the electronic properties of the primary electron donor. R. E. Blankenship is investigating the structure and function of chlorosome antennas in green photosynthetic bacteria. D. Brume is investigating the organization of chlorosomes and characterizing the role of proteins in chlorosomes. W. D. Frasch is studying the structure and mechanism of the two manganese requiring photosynthetic enzymes, the oxygen evolving complex and the energy transducing complex. D. Gust, T. A. Moore and A. L. Moore are investigating artificial photosynthesis systems where proteins have been replaced by covalent linkages between pigments molecules. S. H. Lin is developing a theory to explain photoinduced electron transfer and femto-second processes. G. R. Seely has developed a self-assembling model of primary charge separation in photosynthesis. W. F. J. Vermaas is optimizing site-directed mutagenesis studies of the acceptor side of photosystem 2. A. N. Webber is studying the biogenesis of photosystem 1 and 2 reaction center complexes in plants, green algae, and cyanobacteria. N. W. Woodbury is studying chimeric reaction centers and a reaction center symmetry mutant. DOE

N91-21699# European Space Agency, Paris (France).
IN VITRO PHOTOREACTIVATION OF TRANSFORMING DNA OF BACILLUS SUBTILIS SPORES AFTER IRRADIATION BY ULTRAVIOLET LIGHT
Corinna Panitz (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne, Germany, F.R.) Nov. 1990 95 p Transl. into ENGLISH of In Vitro-Photoreaktovierung von Transformierender DNA aus Bacillus Subtilis-Sporen Nach Bestrahlung mit Ultraviollettem Licht (Cologne, Fed. Republic of Germany, DLR), 1989 99 p Original language document was announced as N90-24710
(ESA-TT-1210; DLR-FB-89-45; ETN-91-98971) Avail: NTIS HC/MF A05

Inactivation of bacteria by UV radiation is caused by photoproducts in the DNA that are insufficiently repaired or not at all. The biological relevance of cis-syn thymine dimer can be tested by photoreactivation. A transforming system of Bacillus subtilis was utilized with in vitro photoreactivation. The UV sensitivity of transformation depends on the state of the DNA: transformation is less UV sensitive, if the DNA is UV irradiated inside the bacterial spore compared to in vitro UV irradiation. In the latter case only, photoreactivation occurs. This system will be used to investigate the photochemical reason of the increased UV-sensitivity of Bacillus subtilis spores, if UV irradiated in vacuum. ESA

N91-21700* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
ROTATING BIO-REACTOR CELL CULTURE APPARATUS Patent
Ray P. Schwarz, inventor (to NASA) and David A. Wolf, inventor (to NASA) 29 Jan. 1991 10 p Filed 30 Jun. 1988 Supersedes N89-14666 (27 - 6, p 803)
(NASA-Case-MSC-21293-1; US-Patent-4,988,623; US-Patent-Appl-SN-213559; US-Patent-Class-435-286; US-Patent-Class-435-284; US-Patent-Class-435-285; US-Patent-Class-435-292; US-Patent-Class-435-311; US-Patent-Class-435-312; US-Patent-Class-435-316) Avail: US Patent and Trademark Office CSCL 06C

A bioreactor system is described in which a tubular housing contains an internal circularly disposed set of blade members and a central tubular filter all mounted for rotation about a common horizontal axis and each having independent rotational support and rotational drive mechanisms. The housing, blade members and filter preferably are driven at a constant slow speed for placing a fluid culture medium with discrete microbeads and cell cultures in a discrete spatial suspension in the housing. Replacement fluid medium is symmetrically input and fluid medium is symmetrically output from the housing where the input and the output are part of a loop providing a constant or intermittent flow of fluid medium in a closed loop. NASA

N91-21701* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
SPIRAL VANE BIOREACTOR Patent
Dennis R. Morrison, inventor (to NASA) 26 Mar. 1991 14 p Filed 29 Nov. 1988 Supersedes N89-25557 (27 - 19, p 2739) Sponsored by NASA. Johnson Space Center
(NASA-Case-MSC-21361-1; US-Patent-5,002,890; US-Patent-Appl-SN-278137; US-Patent-Class-435-286; US-Patent-Class-435-289; US-Patent-Class-435-311; US-Patent-Class-435-315; US-Patent-Class-435-316; US-Patent-Class-210-396; Int-Patent-Class-C12M-03/06) Avail: US Patent and Trademark Office CSCL 06C

A spiral vane bioreactor of a perfusion type is described in which a vertical chamber, intended for use in a microgravity condition, has a central rotating filter assembly and has flexible membranes disposed to rotate annularly about the filter assembly. The flexible members have end portions disposed angularly with respect to one another. A fluid replenishment medium is input from a closed loop liquid system to a completely liquid filled chamber containing microcarrier beads, cells and a fluid medium. Output of spent medium is to the closed loop. In the closed loop, the output and input parameters are sensed by sensors. A manifold permits recharging of the nutrients and pH adjustment. Oxygen is supplied and carbon dioxide and bubbles are removed and the system is monitored and controlled by a microprocessor. NASA

N91-21702# Chicago Univ., IL.
SPECIFICITY OF MUTATION INDUCED BY IONIZING RADIATION AND OXIDIZING FREE RADICALS
B. S. Strauss Oct. 1990 9 p
(Contract DE-FG02-88ER-60678)
(DE91-008838; DOE/ER-60678/3) Avail: NTIS HC/MF A02

The overall goal of this work is an understanding of the molecular mechanisms by which ionizing radiation damage is converted to mutation. We assume that induced mutation occurs as a result of DNA synthesis past damaged nucleotide bases (translesion synthesis). The mutational process can be dissected into three parts. If one considers a growing chain stopped just before a lesion, one can study an addition step in which a new base is aided opposite the damaged site, an elongation step in which additional bases are added to permit synthesis past the lesion, and an excision step which competes with the elongation step and results in removal of the added base. Polymerases have an inherent specificity in the absence of template and tend, in the absence of an instructional site or lesion, to add adenine nucleotides. This overall viewpoint accounts for a great deal of the published data on mutational specificity. There are three main conclusions from our work of the grant period, relevant to this hypothesis. First, suppression of 3' (yields) 5' exonuclease activity provides additional time for the elongation reaction to occur. Second, ionizing radiation results in frame shift mutations at runs of pyrimidines as though non-instructive lesions were produced at these sites. Finally, ionizing radiation induced mutations produced as a result of base damage occur mainly at C's with a deficiency of base substitutions at the site of T's as would be expected if A's were inserted opposite damaged bases. DOE

N91-21703# Pennsylvania State Univ., University Park. Dept. of Agronomy.
COMPARISON OF THE ACTIVITY OF SUBSURFACE AND SURFACE MICROORGANISMS AND THEIR ANAEROBIC TRANSFORMATION OF HETEROCYCLIC COMPOUNDS
J.-M. Bollag Feb. 1991 14 p
(Contract DE-FG02-87ER-60556)
(DE91-008839; DOE/ER-60556/T2) Avail: NTIS HC/MF A03

The physiological characteristics were compared of microorganisms derived from subsurface and surface environments and their ability to transform heterocyclic aromatic chemicals. Essentially indole and pyridine compounds were selected as representatives of heterocyclic compounds. The samples investigated originated from the subsurface drillings at the Savannah River Plant, from surface samples in Pennsylvania, from municipal sewage of State College, Pennsylvania, and from pyridine-contaminated sites at Indianapolis. At different physiological conditions (aerobic, denitrifying, sulfate reducing or methanogenic), different groups of microorganisms are active. Not only the thermodynamics of microbial physiology vary, but different metabolic pathways are used by the various types of microbial processes. Therefore, it was important to determine under which physiological conditions a compound was metabolized, and to clarify the metabolic conditions under which intermediate(s) were produced. DOE

52 AEROSPACE MEDICINE

Includes physiological factors; biological effects of radiation; and effects of weightlessness on man and animals.

N91-21704*# National Aeronautics and Space Administration, Washington, DC.
RADIATION HEALTH RESEARCH, 1986 - 1990
Mar. 1991 114 p
(Contract NASw-4292)

(NASA-TM-4270; NAS 1.15:4270) Avail: NTIS HC/MF A06 CSCL 06R

A collection of 225 abstracts of radiation research sponsored by NASA during the period 1986 through 1990 is reported. Each abstract was categorized within one of four discipline areas: physics, biology, risk assessment, and microgravity. Topic areas within each discipline were assigned as follows: Physics - atomic physics, nuclear science, space radiation, radiation transport and shielding, and instrumentation; Biology - molecular biology, cellular radiation biology, tissue, organs and organisms, radioprotectants, and plants; Risk assessment - radiation health and epidemiology, space flight radiation health physics, inter- and intraspecies extrapolation, and radiation limits and standards; and Microgravity. When applicable subareas were assigned for selected topic areas. Keywords and author indices are provided. Author

N91-21705# Imatran Voima Oy, Helsinki (Finland).
THE PHYSIOLOGICAL EFFECTS OF 50/60 Hz ELECTROMAGNETIC FIELDS: STANDARDS AND GUIDELINES
Leena Korpinen and Jarno Partanen (Tampere Univ. of Technology, Finland) 1990 94 p In FINNISH; ENGLISH summary
(DE91-752996; IVO-A-01/90; ISBN-951-8928-37-1; ISSN-0782-7415) Avail: NTIS HC/MF A05

The Tampere University of Technology has started a study, The Physiological Effects of 50/60 Hz Electromagnetic Fields. The research is being financed by Imatran Voima Oy, Finnish Work Environment Fund and Tampere University of Technology. One of the objectives of this study is to examine standards and guidelines of different countries, concerning exposure to 50/60 Hz electric and magnetic fields. In German standard DIN VDE 0848, Safety in electromagnetic fields, the limit of exposure to 50/60 Hz electric fields is 20 kV/m and the limit of exposure to 50/60 Hz magnetic fields is 5 mT. IRPA (International Radiation Protection Association) has compiled the interim guidelines on limits of exposure to 50/60 Hz electric and magnetic fields. In these interim guidelines continuous occupational exposure during the working day should be limited to rms unperturbed electric field strengths not greater than 10 kV/m and to rms magnetic densities not greater than 0.5 mT. The duration of short-term occupational exposure to electric fields between 10 and 30 kV/m may be calculated from the formula t smaller than or equal to 80/E. Short-term occupational exposure to rms magnetic densities may not exceed 5 mT. Members of general public should not be exposed on a continuous basis to unperturbed rms electric field strengths exceeding 5 kV/m or to magnetic flux densities exceeding 0.1 mT. When the limits were compared with the measured values of electro-magnetic fields, it was found, that in Finland occupational exposure during the working day doesn't exceed the limits. The general public exposure doesn't exceed the limits either. Comparing the results of the studies with electromagnetic fields existing in Finland, it could be noticed, that short-term exposure doesn't cause health risks in Finland. Scientific studies don't indicate, that the continuous exposure causes health risks, neither, that the continuous exposure can't cause health risks. DOE

N91-21706# Naval Biodynamics Lab., New Orleans, LA.
PHYSIOLOGY DATA ACQUISITION SYSTEM DESCRIPTION
Mark L. Lotz 1 Oct. 1990 51 p
(AD-A231088; NBDL-90R004) Avail: NTIS HC/MF A04 CSCL 06/4

This technical report describes the Physiology Data Acquisition System used at NAVBIODYNLAB to acquire, record, and reproduce physiological responses from human research volunteers subjected to short duration accelerations. The system is used to acquire data such as electrocardiograms, electromyograms, and somatosensory evoked responses. The impact accelerations are provided by horizontal and vertical accelerators. This report describes the systems used for physiology data acquisition during experiments performed on the horizontal and vertical accelerators. The equipment used and the interconnection of the equipment are discussed in detail. GRA

N91-21707# Naval Air Development Center, Warminster, PA. Air Vehicle and Crew Systems Technology Dept.
ENHANCING TOLERANCE TO ACCELERATION (+Gz) STRESS: THE HOOK MANEUVER Final Report, 1-14 Aug. 1990
James E. Whinnery and Duane C. Murray 20 Aug. 1990 17 p
(AD-A231094; NADC-90088-60) Avail: NTIS HC/MF A03 CSCL 06/10

Anti-G straining maneuvers (AGSM) have been utilized by aircrew to enhance tolerance to +Gz stress and reduce the potential for +Gz-induced loss of consciousness (G-LOC). Based on many years of teaching individuals to perform an optimum AGSM, one particular technique has proven to be especially useful. This technique is referred to as the Hook maneuver. We strongly prefer not giving a particular name (such as M-1 or L-1) to the AGSM when training aircrew. The Hook maneuver simply emphasizes the proper mechanics for physiological enhancement of tolerance. Experience with training a large number of tactical aircrew on the centrifuge has proven the Hook maneuver to be an extremely effective teaching tool which is easily understood, rapidly mastered, and easily remembered. A description of the Hook maneuver has been requested by many interested groups and is described in this manuscript. It should be emphasized that the optimum AGSM for an individual aviator in a given aerial combat situation is the one that is most effective for him in that situation. GRA

N91-21708# Federal Aviation Administration, Washington, DC. Office of Aviation Medicine.
INHALATION TOXICOLOGY. 11: THE EFFECT OF ELEVATED TEMPERATURE ON CARBON MONOXIDE TOXICITY
Donald C. Sanders and Boyd R. Endecott Dec. 1990 18 p
(AD-A231185; DOT/FAA/AM-90/16) Avail: NTIS HC/MF A03 CSCL 06/11

Laboratory rats were exposed (1) to experimental concentrations of carbon monoxide in air at ambient temperature, (2) to elevated temperature atmospheres from 40 to 60 C, and (3) to selected carbon monoxide (CO) concentrations at the elevated temperatures in (2). The incapacitating potency of each of the environments was evaluated by measurements of time-to-incapacitation (t sub i) as a function of CO concentration and/or temperature; incapacitation was defined operationally as loss of ability to walk inside a motor-driven, rotating cage enclosed in an exposure chamber. Comparison of data from the combined (CO + elevated temperature) exposures and exposures to CO and elevated temperatures alone indicated than incapacitation occurred earlier when CO inhalation was combined with a whole-body, elevated temperature environment than was observed for the same exposure parameters applied individually. No evidence for a synergistic effect was noted. An empirical equation was derived that allows the calculation of a predicted t sub i for combinations of CO and temperature within the rangers utilized in the experimental exposures. GRA

N91-21709# Naval Air Development Center, Warminster, PA. Air Vehicle and Crew Systems Technology Dept.
THE DEVELOPMENT OF PERCEPTUAL/MOTOR AND COGNITIVE PERFORMANCE MEASURES UNDER A HIGH-G ENVIRONMENT: A PRELIMINARY STUDY Final Report, Dec. 1988 - Apr. 1990
John E. Deaton, Michael Holmes, Norman Warner, and Edward Hitchcock 4 Sep. 1990 23 p
(AD-A231289; NADC-90065-60) Avail: NTIS HC/MF A03 CSCL 05/9

There is currently a lack of data on the operator's ability to perform flight and weapon systems management functions under a high-G environment. The ability to correctly track enemy targets and respond with appropriate countermeasures is dependent upon the operator's ability to perform both perceptual/motor and cognitive functions. At the present, not enough information is available to determine how these two functions operate under high-G. GRA

N91-21710# Krug International, San Antonio, TX. Technology Services Div.
AN ANNOTATED BIBLIOGRAPHY OF HYPOBARIC DECOMPRESSION SICKNESS RESEARCH CONDUCTED AT THE CREW TECHNOLOGY DIVISION, USAF SCHOOL OF AEROSPACE MEDICINE, BROOKS AFB, TEXAS FROM 1983 TO 1988 Interim Report, 1 Jun. 1983 - 31 Mar. 1989
James T. Webb, Robert W. Krutz, Jr., and Gene A. Dixon Jun. 1990 26 p Revised
(Contract F33615-85-C-4503)
(AD-A231355; USAFSAM-TP-88-10R) Avail: NTIS HC/MF A03 CSCL 06/4

Four major protocols, one of which includes five studies, have been initiated or completed in the 5-year period from 1983 to 1988. The studies have resulted in numerous publications which are listed as the references for this review. The purpose of this review is to provide an accessible summary of these extensive efforts and document the history of their accomplishments. The cross-reference information contained in this review is intended to simplify data accession within both published and data base records. A listing of the abbreviated title, protocol approval information, sponsorship information, computer database (HYPOB) retrieval numbers/titles, dates of exposure, and information about subjects, prebreathe, and exposure parameters for each study is followed by the published abstracts from each publication. GRA

53 BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

N91-21711# Air Force Human Resources Lab., Brooks AFB, TX.
A CONCEPTUAL MODEL OF THE PERFORMANCE OF THE UNITED STATES AIR FORCE FLIGHT TRAINING PROGRAM Final Report
John P. McGarrity, Larry T. Looper, and R. S. Curtis Jan. 1991 14 p
(AD-A230881; AFHRL-TP-88-33) Avail: NTIS HC/MF A03 CSCL 05/6

A conceptual approach is presented for measuring the program performance of the Air Force Flight Training Program (FTP). There are five sections: The introduction provides the background information on four different FTP options addressed by Stoker, Hunter, Kanto, Quebe, and Siem (1987) and establishes the general construction of the program performance model; the second section addresses the effectiveness of the FTP in relation to graduation rates; the efficiency section develops the cost for each of the FTP options; the fourth section, on performance, presents a way to compare the efficiency and effectiveness of each program; and the concluding section provides a summary of the benefits to be derived from use of one of the four option. GRA

54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human engineering; biotechnology; and space suits and protective clothing.

For related information see also *16 Space Transportation.*

N91-21712# Federal Aviation Administration, Washington, DC.
NATIONAL PLAN FOR AVIATION HUMAN FACTORS, VOLUME 1
Nov. 1990 51 p Prepared in cooperation with Computer Technology Associates, Inc., Rockville, MD
(PB91-100339; PB91-100321) Avail: NTIS HC/MF A04; also available in set of 2 reports as PB91-100321 CSCL 05H

The scope, objectives and an overview of the National Plan for Human factors is presented. The development of the plan, implementation and application to the National Aerospace System, the institutionalization of human factors and general recommendations are also discussed. Author

N91-21713# Federal Aviation Administration, Washington, DC.
NATIONAL PLAN FOR AVIATION HUMAN FACTORS, VOLUME 2
Nov. 1990 850 p Prepared in cooperation with Computer Technology Associates, Inc., Rockville, MD
(PB91-100347; PB91-100321) Avail: NTIS HC/MF A99; also available in set of 2 reports as PB91-100321 CSCL 05H

Detailed descriptions of the technical agenda, the flightdeck plan, aircraft maintenance plan, airway facilities maintenance plan, air traffic control plan, and flightdeck/air traffic control plan are reported. Author

N91-21714*# Battelle Columbus Labs., Mountain View, CA.
HUMAN FACTORS IN AVIATION: TERMINAL CONTROL AREA BOUNDARY CONFLICTS
William P. Monan Feb. 1989 36 p
(Contract NAS2-11934)
(NASA-CR-177522; NAS 1.26:177522) Avail: NTIS HC/MF A03 CSCL 05H

Air-to-air conflicts in the vicinity of Terminal Control Area (TCA) boundaries were studied to obtain a better understanding of the causal dynamics of these events with particular focus on human factor issues. The study dataset consisted of 381 Instrument Flight Rules/Visual Flight Rules (IFR/VFR) traffic conflicts in airspace layers above TCA ceiling and below TCA floors; 213 reports of incursions in TCA terminal airspace by VFR aircraft, of which 123 resulted in conflicts; and an additional set of reports describing problems with Air Traffic Control (ATC) services in and around TCAs. Results and conclusions are detailed. Author

N91-21715# Food and Agriculture Organization of the United Nations, Rome (Italy).
INTERNATIONAL DOCUMENT ON FOOD IRRADIATION
Jun. 1990 10 p Presented at the International Conference on Acceptance, Control of and Trade in Irradiated Foods, Geneva, Switzerland, 16-20 Dec. 1988 Presented in cooperation with World Health Organization, Geneva, Switzerland; International Atomic Energy Agency, Vienna, Austria; International TradeCentre UNCTAD/GATT, Geneva, Switzerland; and Atomic Energy Commission, Damascus, Syria
(DE91-615879; AECS/IB-4; CONF-881204) Avail: NTIS HC/MF A02

This international document highlights the major issues related to the acceptance of irradiated food by consumers, governmental and intergovernmental activities, the control of the process, and trade. The conference recognized that: Food irradiation has the potential to reduce the incidence of foodborne diseases. It can reduce post-harvest food losses and make available a larger quantity and a wider variety of foodstuffs for consumers. Regulatory control by competent authorities is a necessary prerequisite for introduction of the process. International trade in irradiated foods would be facilitated by harmonization of national procedures based on internationally recognized standards for the control of food irradiation. Acceptance of irradiated food by the consumer is a vital factor in the successful commercialization of the irradiation process, and information dissemination can contribute to this acceptance. DOE

N91-21716# Logicon Technical Services, Inc., Dayton, OH.
A COMPATIBILITY ASSESSMENT OF THE PROTECTIVE INTEGRATED HOOD MASK WITH ANVIS NIGHT VISION GOGGLES Final Report, Jan. - Mar. 1990
Mary M. Donohue-Perry Jul. 1990 31 p
(Contract F33615-89-C-0532)
(AD-A229956; AAMRL-TR-90-030) Avail: NTIS HC/MF A03 CSCL 05/8

Potential compatibility problems found with the Protective Integrated Hood Mask (PIHM) and the Aviator's Night Vision Imaging System (ANVIS) were evaluated. The PIHM is worn under

a standard HGU-55/P helmet and is designed to protect USAF aircrew members in a chemical environment. Visual acuity through ANVIS/PIHM, ANVIS horizontal and vertical intensified of view while wearing PIHM, and distortion and transmissivity of the PIHM visor were determined. Acuity through ANVIS with and without PIHM was assessed under quarter moon and starlight illumination. Acuity was tested using 20 and 90 percent contrast Landolt C targets depicted in one of four orientations. ANVIS/PIHM viewing resulted in acuity reductions of approximately 6 percent for both contrast levels at quarter moon illumination. No acuity loss was present at starlight illumination. Tests of horizontal and vertical ANVIS intensified fields of view resulted in no significant losses when PIHM was donned. GRA

N91-21717# Air Force Occupational and Environmental Health Lab., Brooks AFB, TX.
RECOMMENDED CARBON DIOXIDE AND RELATIVE HUMIDITY LEVELS FOR MAINTAINING ACCEPTABLE INDOOR AIR QUALITY Final Report
David Carpenter and Bruce J. Poitrast Oct. 1990 35 p
(AD-A230026; AFOEHL-90-169CA00111KGA) Avail: NTIS HC/MF A03 CSCL 06/9

At the request of the AFLC Surgeon, AFOEHL prepared a recommendation for carbon dioxide and relative humidity levels to maintain adequate indoor air quality. The report summarizes and analyzes the results of approximately 75 building investigations and makes recommendations for controlling indoor air quality by use of carbon dioxide levels. The report discusses the symptoms and signs found in occupants and the possible causes for same. A draft of this report was previously released under the title, Proposed Indoor Air Quality Standard for AFLC/SG, Oct. 90 AFOEHL Report number 90-169CA00111KGA. GRA

N91-21718# Logicon, Inc., Dayton, OH.
A FIELD EVALUATION OF THE COMPATIBILITY OF THE PROTECTIVE INTEGRATED HOOD MASK WITH ANVIS NIGHT VISION GOGGLES Final Report, Jan. - Mar. 1990
Joseph T. Riegler and Mary M. Donohue-Perry Jul. 1990 25 p
(Contract F33615-89-C-0532)
(AD-A230237; AAMRL-TR-90-031) Avail: NTIS HC/MF A03 CSCL 17/5

An evaluation was conducted to determine potential compatibility problems found while wearing the Protective Integrated Hook Mask (PIHM) with the Aviator's Night Vision Imaging Systems(ANVIS). The PIHM is worn under a standard HGU-55/P helmet and is designed to protect USAF aircrew members in a chemical environment. ANVIS is mounted in the front of the PIHM visor using a special bracket. The evaluation consisted of tests performed at Pope AFB, NC using qualified C-130E crewmembers. Examinations of horizontal and vertical intensified fields of view, cockpit lighting capability, and a limited fit evaluation were conducted. Testing showed that ANVIS/PIHM viewing resulted in average losses of horizontal and vertical fields of view of 2.6 and 2.1 deg. C-130E cockpits lighting interference was not found when viewing through the AVIS/PIHM, or under the ANVIS through the PIHM visor. No significant problems in achieving proper fit with ANVIS/PIHM were found. Overall conclusions were that potential compatibility problems of ANVIS and PIHM integration can be reduced or eliminated with proper fit and adjustment of the ANVIS/PIHM. GRA

N91-21719*# Naval Air Development Center, Warminster, PA. Air Vehicle and Crew Systems Technology Dept.
VENTILATION LOSS AND PRESSURIZATION IN THE NASA LAUNCH/ENTRY SUIT: POTENTIAL FOR HEAT STRESS Final Report, 1 Aug. - 15 Sep. 1989
Jonathan W. Kaufman, Katherine Y. Dejneka, and Gregory K. Askew 15 Sep. 1989 21 p Sponsored by NASA, Johnson Space Center
(NASA-CR-188075; Rept-387929; NAS 1.26:188075; AD-A230318; NADC-90069-60) Avail: NTIS HC/MF A03 CSCL 06/11

The potential of the NASA Launch/Entry Suit (LES) for producing heat stress in a simulated Space Shuttle cabin environment was studied. The testing was designed to identify potential heat stress hazards if the LES were pressurized or if ventilation were lost. Conditions were designed to simulate an extreme pre-launch situation with chamber temperatures maintained at dry bulb temperature = 27.2 +/- 0.1 C, globe temperature = 27.3 +/- 0.1 C, and wet bulb temperature = 21.1 +/- 0.3 C. Two females and two males, 23 to 34 years of age, were employed in this study, with two subjects having exposures in all 3 conditions. Test durations in the ventilated (V) and unventilated (UV) conditions were designed for 480 minutes, which all subjects achieved. Pressurized runs (Pr) were designed for 45 minutes, which all subjects also achieved. While some significant differences related to experimental conditions were noted in rectal and mean skin temperatures, evaporation rates, sweat rates, and heart rate, these differences were not thought to be physiologically significant. The results indicate that the LES garment, in either the Pr or UV state, poses no danger of inducing unacceptable heat stress under the conditions expected within the Space Shuttle cabin during launch or reentry. GRA

N91-21720# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Aerospace Medical Panel Working Group 14.
HIGH G PHYSIOLOGICAL PROTECTION TRAINING
1991 98 p
(AGARD-AG-322; ISBN-92-835-0596-4) Copyright Avail: NTIS HC/MF A05; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

High-G physiological protection training is currently of importance to NATO Air Force operations because of a deficiency in g protection methods. This deficiency can, and on occasion does, result in G-induced Loss of Consciousness (G-LOC). Consequently, these methods are supported and supplemented by increasing their effectiveness through: increased understanding of the physiologic basis of g protection; development of advanced g protection concepts; knowledge of the system and basis of G-LOC; identification of the existence and location of human use centrifuges in NATO countries; increased physical conditioning; improved training of pilots on the centrifuge; and establishment of training goals and standards. These topics are addressed at a scientific or technical level of knowledge that is possessed by everyone involved in acceleration research, g training, flying, or designing and building high performance aircraft. At the end of each chapter is a brief summary in both English and French.
Author

N91-21721# Army Natick Labs., MA.
THE EFFECTS OF CHEMICAL PROTECTIVE GLOVES AND GLOVE LINERS ON MANUAL DEXTERITY Final Technical Report, Dec. 1988 - Jan. 1990
Richard A. Teixeira and Carolyn K. Bensel Dec. 1990 47 p
(AD-A231250; NATICK/TR-91/002) Avail: NTIS HC/MF A03 CSCL 15/6

The effect were determined on manual dexterity performance of two thickness of butyl, chemical protective gloves, 0.64 mm and 0.36 mm, and of two types of cotton glove liners, a seam-stitched and a stingknit version. Over seven working days, 12 male subjects performed three, fine-finger dexterity tests while bare handed and while wearing each of the four glove and liner combinations. The subjects also completed a questionnaire designed to elicit their opinions of the handwear. Analyses of the subjects' times to test completion with the glove and liner combinations, expresses as a percentage of bare hand times, failed to yield any significant interactions among the glove, the liner, and testing session variables. Also, the main effect of liner type did not reach significance, but the main effects of glove and of session did. The subjects' performance improved across sessions and was better when the 00.36-mm gloves were torn than when the 0.64-mm gloves were used. Although the subjects expressed a definite preference for the thinner butyl gloves, they did not consistently choose one cotton liner as being superior to

the other. When forced to select the one liner that they preferred, 8 of 12 subjects chose the string-knit version. GRA

N91-21722# Army Research Inst. for the Behavioral and Social Sciences, Alexandria, VA.
HUMAN PERFORMANCE CONCERNS FOR THE TRACKWOLF SYSTEM Final Report, Jan. 1989 - Jan. 1990
Beverly G. Knapp and Mary J. Hall Dec. 1990 33 p
(AD-A231359; ARI-RN-91-14) Avail: NTIS HC/MF A03 CSCL 05/8

Findings are presented from site visits to two operational systems (OUTS and TRACKFINDER), which are predecessors to the objective TRACKWOLF system under development. The purpose of the site visits was to obtain lessons learned, operator workload estimates, and critical high-driver tasks. These data were used as a baseline for comparing operator capabilities and as a precursor to use in TRACKWOLF operational tests. Findings indicated significant frustration with equipment operations and communication capability of OUTS and TRACKFINDER. This was also revealed by a high rating on the workload scale (NASA-Task Load Index) on frustration and temporal demand subfactors. Over 50 pct. of the tasks were judged high workload and difficult cognitive load for operators. Results have been provided to proponent combat developer and trainer personnel. GRA

N91-21723# Naval Postgraduate School, Monterey, CA.
A TOOLKIT FOR DESIGNING USER INTERFACES M.S. Thesis
Susan L. Dunlap Mar. 1990 77 p
(AD-A231558) Avail: NTIS HC/MF A05 CSCL 12/5

Current methods of developing user interfaces for IRIS workstation application programs are inefficient. In order to help speed the development of complex graphics programs, IRIS workstation users need a toolkit that will assist in the design and implementation of user interfaces for graphics programs. This project presents the preliminary work on an interface generator for the Silicon Graphics, Inc. IRIS workstation. The NPS Interface Builder (NPS IB) is designed to speed the creation of application programs by allowing a user to define an interface graphically rather than by writing C code. The program provides on-screen editing, facilitated by a number of program features. NPS IB can be used to develop the basic framework of a graphics program, or can be user to enhance the capabilities of an already existing graphics application. GRA

55 SPACE BIOLOGY

Includes exobiology; planetary biology; and extraterrestrial life.

No abstracts in this category.

59 MATHEMATICAL AND COMPUTER SCIENCES (GENERAL)

No abstracts in this category.

60 COMPUTER OPERATIONS AND HARDWARE

Includes hardware for computer graphics, firmware, and data processing.

For components see *33 Electronics and Electrical Engineering.*

N91-21724*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
PERFORMANCE EFFECTS OF IRREGULAR COMMUNICATIONS PATTERNS ON MASSIVELY PARALLEL MULTIPROCESSORS Final Report
Joel Saltz, Serge Petiton, Harry Berryman, and Adam Rifkin (College of William and Mary, Williamsburg, VA.) Jan. 1991 23 p
Submitted for publication
(Contract NAS1-18605; NSF ASC-88-19373; NSF ASC-88-19374)
(NASA-CR-187514; NAS 1.26:187514; ICASE-91-12) Avail: NTIS HC/MF A03 CSCL 09B

A detailed study of the performance effects of irregular communications patterns on the CM-2 was conducted. The communications capabilities of the CM-2 were characterized under a variety of controlled conditions. In the process of carrying out the performance evaluation, extensive use was made of a parameterized synthetic mesh. In addition, timings with unstructured meshes generated for aerodynamic codes and a set of sparse matrices with banded patterns on non-zeroes were performed. This benchmarking suite stresses the communications capabilities of the CM-2 in a range of different ways. Benchmark results demonstrate that it is possible to make effective use of much of the massive concurrency available in the communications network. Author

N91-21725# Brookhaven National Lab., Upton, NY.
VM-CMS TUTORIAL
Apr. 1990 222 p
(Contract DE-AC02-76CH-00016)
(DE91-009444; BNL-41530-2nd-Ed) Avail: NTIS HC/MF A10

This report discusses the following topics: using VM-CMS; using your virtual machine; the editor (Xedit); more Xedit; properties of your virtual machine; help; adapting CMS to your taste; and communicating with other users and transferring files. Additional topics include: backup and disk storage on VM/XA; creating and running programs; the batch machine; reading and writing tapes; the FORTRAN full screen interactive debugger IAD; and the vector facility. DOE

N91-21726# Naval Research Lab., Washington, DC.
NOISE EFFECTS UPON A SIMPLE TIMING CHANNEL Memorandum Report
Ira S. Moskowitz 21 Dec. 1990 20 p
(AD-A230818; NRL-MR-6740) Avail: NTIS HC/MF A03 CSCL 12/9

The effects of noise upon a covert timing channel in a multi-user computer system is investigated. Shannon's information theory is used to quantify the resulting information flow across the channel. Possible Trojan Horse strategies are also discussed. GRA

N91-21727# University of Southern California, Marina del Rey. Information Sciences Inst.
A RESEARCH PROGRAM IN COMPUTER TECHNOLOGY Final Technical Report, Jul. 1981 - Nov. 1989
Herbert Schorr 31 Dec. 1990 26 p
(Contract MDA903-81-C-0335; ARPA Order 4242)
(AD-A231025) Avail: NTIS HC/MF A03 CSCL 12/5

The ISI Information Processing Center provides support in four distinct, though tightly interrelated, areas: Hardware, Systems Software, Operations, and Networks Services. The overall charter of the organization is to assure that the needs of the user community are addressed and protected as efficaciously as possible. To achieve this end, each group is concerned about the effective use of the machines and software tools, and about the

security of the physical plant, the system files, and other online information. GRA

61 COMPUTER PROGRAMMING AND SOFTWARE

Includes computer programs, routines, alogorithms, and specific applications, e.g., CAD/CAM.

N91-21728*# Columbia Univ., New York, NY. Astrophysics Lab.
ANALYSIS AND INTERPRETATION OF DIFFUSE X-RAY EMISSION USING DATA FROM THE EINSTEIN SATELLITE Final Technical Report
David J. Helfand Mar. 1991 59 p
(Grant NAG8-803)
(NASA-CR-187988; NAS 1.26:187988; CAL-1884) Avail: NTIS HC/MF A04 CSCL 09B

An ambitious program to create a powerful and accessible archive of the HEAO-2 Imaging Proportional Counter (IPC) database was outlined. The scientific utility of that database for studies of diffuse x ray emissions was explored. Technical and scientific accomplishments are reviewed. Three papers were presented which have major new scientific findings relevant to the global structure of the interstellar medium and the origin of the cosmic x ray background. An all-sky map of diffuse x ray emission was constructed. B.G.

N91-21729*# Colorado Univ., Boulder. Center for Space Structures and Controls.
ANALYSIS, PRELIMINARY DESIGN AND SIMULATION SYSTEMS FOR CONTROL-STRUCTURE INTERACTION PROBLEMS Final Report
K. C. Park and Kenneth F. Alvin Jan. 1991 164 p
(Grant NAG1-1021)
(NASA-CR-188018; NAS 1.26:188018; CU-CSSC-91-6) Avail: NTIS HC/MF A08 CSCL 09B

Software aspects of control-structure interaction (CSI) analysis are discussed. The following subject areas are covered: (1) implementation of a partitioned algorithm for simulation of large CSI problems; (2) second-order discrete Kalman filtering equations for CSI simulations; and (3) parallel computations and control of adaptive structures. For individual titles, see N91-21730 through N91-21732.

N91-21730*# Colorado Univ., Boulder. Center for Space Structures and Controls.
IMPLEMENTATION OF A PARTITIONED ALGORITHM FOR SIMULATION OF LARGE CSI PROBLEMS
Kenneth F. Alvin and K. C. Park *In its* Analysis, Preliminary Design and Simulation Systems for Control-Structure Interaction Problems Jan. 1991 113 p (For primary document see N91-21729 13-61)
(CU-CSSC-91-4) Avail: NTIS HC/MF A08 CSCL 09B

The implementation of a partitioned numerical algorithm for determining the dynamic response of coupled structure/controller/estimator finite-dimensional systems is reviewed. The partitioned approach leads to a set of coupled first and second-order linear differential equations which are numerically integrated with extrapolation and implicit step methods. The present software implementation, ACSIS, utilizes parallel processing techniques at various levels to optimize performance on a shared-memory concurrent/vector processing system. A general procedure for the design of controller and filter gains is also implemented, which utilizes the vibration characteristics of the structure to be solved. Also presented are: example problems; a user's guide to the software; the procedures and algorithm scripts; a stability analysis for the algorithm; and the source code for the parallel implementation. Y.S.

N91-21731*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
SECOND-ORDER DISCRETE KALMAN FILTERING EQUATIONS FOR CONTROL-STRUCTURE INTERACTION SIMULATIONS
K. C. Park, W. Keith Belvin, and Kenneth F. Alvin (Colorado Univ., Boulder.) *In* Colorado Univ., Analysis, Preliminary Design and Simulation Systems for Control-Structure Interaction Problems Jan. 1991 28 p (For primary document see N91-21729 13-61)
(CU-CSSC-91-5) Avail: NTIS HC/MF A08 CSCL 09B

A general form for the first-order representation of the continuous, second-order linear structural dynamics equations is introduced in order to derive a corresponding form of first-order Kalman filtering equations (KFE). Time integration of the resulting first-order KFE is carried out via a set of linear multistep integration formulas. It is shown that a judicious combined selection of computational paths and the undetermined matrices introduced in the general form of the first-order linear structural systems leads to a class of second-order discrete KFE involving only symmetric, N x N solution matrix. Author

N91-21732*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
PARALLEL COMPUTATIONS AND CONTROL OF ADAPTIVE STRUCTURES
K. C. Park, Kenneth F. Alvin, W. Keith Belvin, K. P. Chong, ed., S. C. Liu, ed., and J. C. Li, ed. (National Central Univ., Chung-Li, Taiwan) *In* Colorado Univ., Analysis, Preliminary Design and Simulation Systems for Control-Structure Interaction Problems Jan. 1991 19 p Repr. from Intelligent Structures (London, England) p 439-458 (For primary document see N91-21729 13-61)
(Contract F49620-87-C-0074)
Avail: NTIS HC/MF A08 CSCL 09B

The equations of motion for structures with adaptive elements for vibration control are presented for parallel computations to be used as a software package for real-time control of flexible space structures. A brief introduction of the state-of-the-art parallel computational capability is also presented. Time marching strategies are developed for an effective use of massive parallel mapping, partitioning, and the necessary arithmetic operations. An example is offered for the simulation of control-structure interaction on a parallel computer and the impact of the approach presented for applications in other disciplines than aerospace industry is assessed. Author

N91-21733*# Missouri Univ., Columbia. Coll. of Engineering.
ENGINEERING SPECIFICATION AND SYSTEM DESIGN FOR CAD/CAM OF CUSTOM SHOES: UMC PROJECT EFFORT Final Report, 1 Jun. 1988 - 31 Dec. 1990
Han P. Bao Mar. 1991 30 p
(Grant NAG1-875)
(NASA-CR-188049; NAS 1.26:188049; UMC-IE-6-0391) Avail: NTIS HC/MF A03 CSCL 09B

The goal of this project is to supplement the footwear design system of North Carolina State University (NCSU) with a software module to design and manufacture a combination sole. The four areas of concentration were: customization of NASCAD (NASA Computer Aided Design) to the footwear project; use of CENCIT data; computer aided manufacturing activities; and beginning work for the bottom elements of shoes. The task of generating a software module for producing a sole was completed with a demonstrated product realization. The software written in C was delivered to NCSU for inclusion in their design system for custom footwear known as LASTMOD. The machining process of the shoe last was improved using a spiral tool path approach. B.G.

N91-21734# Mei Associates, Inc., Lexington, MA.
INSTRUCTIONAL SUPPORT SYSTEM (ISS). BEGINNER'S MANUAL (ZENITH 248 VERSION ONLY)
1990 856 p

(Contract F33615-88-C-0003)
(PB91-127332; DOD/SW/DK-90/008R) Avail: NTIS HC/MF A99 CSCL 09B

The MicroISS (Instructional Support System) Beginner's Manual is designed for novice Zenith 248 ISS users. It provides high level instruction on how to use the following editors/programs: User Editor; CAI Authoring Support System (CASS) Editor, including videodisc capabilities; Graphics Editor (GrEdt); Simulation Dialogue Editor (SID); Glossary Editor; MicroManager; and MicroSequencer. The most commonly used menu options of each of these editors are explained as well as the shortcuts. GRA

N91-21735# Frontier Technology, Inc., Beavercreek, OH.
METHODOLOGY DEVELOPMENT FOR THE VERIFICATION AND VALIDATION OF FLIGHT CRITICAL SYSTEMS SOFTWARE, PHASE 1 Final Report, Dec. 1989 - Aug. 1990
Ronald L. Braet Oct. 1990 107 p
(Contract F33615-89-C-3610)
(AD-A229932; FTI-9042-001-Phase-1; WRDC-TR-90-3067-Phase-1) Avail: NTIS HC/MF A06 CSCL 12/5

The results of this conceptual design study have that there is a growing need to develop a methodology by which flight critical systems (FCS) software can be verified and validated for performance and safety impacts. The nature of the evolving technology and its application to FCS Software verification an validation requirements has current V and V methods lagging behind design methods and tools. It is recognized throughout government and industry that FCS software V and V requires knowledgeable and skilled individuals utilizing proper tools and techniques to successfully complete the V and V effort in a timely manner. This report provides an overview of the development process of flight critical systems and the roles of verification an validation which go hand-in-hand with the development process. It provides a conceptual design for a computer aided environment to perform FCS software verification and validation. Current trends in applications of advanced control and integration technologies are bringing about the development of on-board systems that are designed to enhance combat effectiveness and survivability in ever increasing hostile combat environments. Flight critical systems (including integrated flight vehicle sensors) are being controlled and integrated in software. GRA

N91-21736# OptiComp Corp., Zephyr Cove, NV.
DIGITAL OPTICAL COMPUTER GLOBAL INTERCONNECT ALGORITHM STUDY Technical Report, Oct. 1989 - Nov. 1990
Peter Guilfoyle Nov. 1990 4 p
(Contract N00014-89-C-0225)
(AD-A230282) Avail: NTIS HC/MF A01 CSCL 12/5

Optical computer technology has demonstrated the potential to offer extremely high computational rates at significant power saving over conventional semi-conductor electronics technology. The leverage over power requirement is extended by the use of global interconnect geometries which allow a larger fan-in per photon than the parallel architectures under study at the time of project inception. The purpose of this project is to study and formulate candidate digital computation primitives to be applied to optical global interconnect geometries to recommend a Global Digital Optical Computer architecture. This project is directed at expanding and enhancing the work completed in a parallel digital optical computer project that is currently underway. The goal is to implement a digital optical computer that surpasses the performance offered by strictly parallel interconnect geometries. This study will revolve about two architectural concerns: optical and computational. The current parallel approaches can be extended to global in discrete steps of complexity. The central principle applied to achieving global interconnects is the Fourier transform properties of any optical system. The interconnect geometries will utilize the autocoherence properties of the laser array emitters; however, all of the emitters will be specified to be mutually incoherent to frustrate different channels from interferometrically coupling at the detector. GRA

N91-21737# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
A LINEAR QUADRATIC REGULATOR WEIGHT SELECTION ALGORITHM FOR ROBUST POLE ASSIGNMENT M.S. Thesis
Jeffrey D. Robinson Dec. 1990 94 p
(AD-A230598; AFIT/GAE/ENY/90D-23) Avail: NTIS HC/MF A05 CSCL 01/4

An advantage of linear quadratic regulator (LQR) design is that it gives a robust system by guaranteeing stability margins. This property is used to develop an algorithm for placing robust poles. The algorithm chooses the positive semi-definite weighting matrix, Q, and positive definite weighting matrix, R, by attempting to place closed loop poles at a set of desired poles. If the desired poles lie outside the allowable LQR region, the algorithm finds the achievable poles inside the region that are closest to the desired poles. The solution requires using a gradient search technique to minimize a weighted eigenvalue difference cost function. The weighting of the eigenvalue difference establishes the relative importance between the poles. In a multi-input multi-output system, the placement of one pole effects the allowable placement region of the other poles. Thus, the heavier weighted poles have precedence and are forces closer to their desired location. The algorithm is programmed to run on the software package MATLAB and the related subroutines are discussed. Several examples are included to illustrate the use of the algorithm, some of which can be solved in closed form to compare with the algorithm's solution. The results show that this technique is accurate for selecting robust poles at or close to he desired pole locations. GRA

N91-21738# Air Force Inst. of Tech., Wright-Patterson AFB, OH.
DETERMINING CONCURRENCY IN OBJECT-ORIENTED DESIGN OF REAL-TIME EMBEDDED SYSTEMS USING Ada M.S. Thesis
Kenneth D. Baum Dec. 1990 156 p
(AD-A230659; AFIT/GCS/ENG/90D-01) Avail: NTIS HC/MF A08 CSCL 12/5

One of the characteristics of real-time systems is concurrency. Designers of real-time systems have traditionally determined system concurrency at implementation time using the facilities of a cyclic executive. With the advent of programming language constructs for specifying concurrency, determining concurrency at design time has become a possibility. Several design methods, all of which are extensions of either structured design or Jackson system development, provide heuristics to help the designer make concurrency decisions. The object-oriented approach, however, has no corresponding heuristics to aid designers of real-time systems. The purpose of this thesis was to develop heuristics to help designers make concurrency decisions in developing object-oriented designs of real-time systems. This was accomplished by examining existing heuristics from other design methods and applying them to the object-oriented paradigm. Four heuristics were developed, the first of which exploits the potential in object-oriented design to model the problem-space. The other three heuristics deal with concurrency which is not necessarily reflected in the problem-space, but must be implemented for practical reasons. The heuristics were validated by applying them to a sample problem, then having the heuristics and the design of the sample problem evaluated by a group of software engineering experts. GRA

N91-21739*# Houston Univ., Clear Lake, TX. Research Inst. for Computing and Information Systems.
AN ENDORSEMENT-BASED APPROACH TO STUDENT MODELING FOR PLANNER-CONTROLLED INTELLIGENT TUTORING SYSTEMS Final Report, Jun. - 31 Dec. 1990
William R. Murray (FMC Corp., Santa Clara, CA.) 31 Dec. 1990 31 p
(Contract NCC9-16)
(NASA-CR-188177; NAS 1.26:188177) Avail: NTIS HC/MF A03 CSCL 09B

An approach is described to student modeling for intelligent

tutoring systems based on an explicit representation of the tutor's beliefs about the student and the arguments for and against those beliefs (called endorsements). A lexicographic comparison of arguments, sorted according to evidence reliability, provides a principled means of determining those beliefs that are considered true, false, or uncertain. Each of these beliefs is ultimately justified by underlying assessment data. The endorsement-based approach to student modeling is particularly appropriate for tutors controlled by instructional planners. These tutors place greater demands on a student model than opportunistic tutors. Numerical calculi approaches are less well-suited because it is difficult to correctly assign numbers for evidence reliability and rule plausibility. It may also be difficult to interpret final results and provide suitable combining functions. When numeric measures of uncertainty are used, arbitrary numeric thresholds are often required for planning decisions. Such an approach is inappropriate when robust context-sensitive planning decisions must be made. A TMS-based implementation of the endorsement-based approach to student modeling is presented, this approach is compared to alternatives, and a project history is provided describing the evolution of this approach. Author

N91-21740# Sandia National Labs., Albuquerque, NM.
A MODIFIED SLIC MATERIAL INTERFACE RECONSTRUCTION ALGORITHM FOR EULERIAN CODES
R. L. Bell (Amparo Corp., Albuquerque, NM.) and J. S. Rottler 1990 10 p Presented at the 1990 Nuclear Explosives Code Developers' Conference, Monterey, 6-9 Nov. 1990
(Contract DE-AC04-76DP-00789)
(DE91-009175; SAND-92-0402C; CONF-9011149-13) Avail: NTIS HC/MF A02

One of the chief disadvantages associated with the use of an Eulerian mesh is the difficulty in accurately constructing material interfaces as materials move through the mesh. The Simple Line Interface Calculation (SLIC) algorithm developed by Noh and Woodward at Lawrence Livermore National Laboratory has been used successfully, but it has certain problems. The SLIC algorithm is accurate only when an interface is parallel or perpendicular to the direction of the flow, and it will modify interfaces that are not oriented perpendicular or parallel to the flow. The Modified SLIC (MSLIC) algorithm presented in this paper greatly improves the accuracy of the SLIC algorithm while retaining much of the simplicity of the original algorithm. MSLIC is available for two and three dimensional calculations. DOE

N91-21741*# Houston Univ., Clear Lake, TX. Research Inst. for Computing and Information Systems.
EXPERIENCE WITH ABSTRACT NOTATION ONE
James D. Harvey and Alfred C. Weaver Jul. 1990 39 p
(Contract NCC9-16)
(NASA-CR-188090; NAS 1.26:188090) Avail: NTIS HC/MF A03 CSCL 09B

The development of computer science has produced a vast number of machine architectures, programming languages, and compiler technologies. The cross product of these three characteristics defines the spectrum of previous and present data representation methodologies. With regard to computer networks, the uniqueness of these methodologies presents an obstacle when disparate host environments are to be interconnected. Interoperability within a heterogeneous network relies upon the establishment of data representation commonality. The International Standards Organization (ISO) is currently developing the abstract syntax notation one standard (ASN.1) and the basic encoding rules standard (BER) that collectively address this problem. When used within the presentation layer of the open systems interconnection reference model, these two standards provide the data representation commonality required to facilitate interoperability. The details of a compiler that was built to automate the use of ASN.1 and BER are described. From this experience, insights into both standards are given and potential problems relating to this development effort are discussed. Author

N91-21742# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
IDEAL, A DIALOGIC INTERFACE IN A NATURAL LANGUAGE FOR EXPERT SYSTEMS Ph.D. Thesis [IDEAL, UMA INTERFACE DIALOGICA EM LIGUAGEM NATURAL PARA SISTEMAS ESPECIALISTAS]
Carlos Alberto deOliveira Oct. 1990 254 p In PORTUGUESE; ENGLISH summary
(INPE-5151-TDL/424) Avail: NTIS HC/MF A12

The IDEAL system is a natural language interface which translates a natural language phrase into a decision rule premise/conclusion. The system is useful for interfacing expert systems during the knowledge acquisition phase. Each input phase is outputted as a number of metalinguistic paraphrases: the user can select what best approaches the desired meaning. The IDEAL understanding power is increased during each system session. The system learns the style, the particular grammer, the semantic world, the significant linguistic relations of the user. In other words, in a particular and specific world, it creates meaningful phrases. The system is initialized with an empty lexical-semantic database, which is filled during an interactive dialog process. Thus, the IDEAL system is a flexible and portable natural language interface. Author

N91-21743# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
IMPLEMENTATION OF A MATRIX THEOREM PROVER FOR PROPOSITIONAL MODAL LOGIC M.S. Thesis, Sussex Univ., Brighton, England, 1 Sep. 1989
Orlando BisacchiCoelho Sep. 1990 167 p Prepared in cooperation with Sussex Univ., Brighton, England
(INPE-5124-RPE/629) Avail: NTIS HC/MF A08

The implementation of a matrix theorem prover for the propositional modal logic S5 is presented. A matrix theorem prover for classical logic is adapted to perform semantic tableaux-based proofs in the modal logic S5 by means of exploring the peculiar accessibility relation defined by the possible-worlds semantics for this logic. This method is easily adaptable to execute proofs in other modal logics. The relevant literature is surveyed and the proof method is presented in detail along with its implementation. The adaptation of the program to work for other logics is discussed. Author

N91-21744# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
IMPLEMENTATION IN TWO CLASSES OF C (++) FOR MORPHOLOGICAL PROCESSING OF IMAGES [IMPLEMENTACAO EM C++ DE DUAS CLASSES PARA O PROCESSAMENTO MORFOLOGICO DE IMAGENS]
Guy Pilchen Dec. 1990 76 p In PORTUGUESE; ENGLISH summary
(INPE-5217-RPE/642) Avail: NTIS HC/MF A05

Object oriented languages allow the creation of easy use and maintenance of image processing systems. A class for gray level images, with the definition of morphological operations is defined. Memory use is optimized thanks to the functions of another class. Morphological operation definition is generic and allows other filtering operation implementation. Author

N91-21745# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
A MONOTONE DECREASING ALGORITHM FOR THE 0-1 MULTIKNAPSACK DUAL PROBLEM
Luiz Antonio Nogueir Lorena and G. Plateau (Paris VIII Univ., Villetaneuse, France) Oct. 1990 24 p Submitted for publication
(INPE-5160-RPE/635) Avail: NTIS HC/MF A03

A monotone decreasing algorithm for the 0-1 multiknapsack dual problem is presented. The subgradient type algorithm solves a continuous surrogate relaxation at each iteration, and a simple control at the subgradient updating produces a monotone decreasing sequence of Lagrangean relaxations. Many

computational tests with problems from the literature are presented. Author

N91-21746# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
IDENTIFICATION OF PARAMETERS DERIVED FROM INERTIAL SENSORS [IDENTIFICACAO DE PARAMETROS DA DERIVA DE SENSORES INERCIALS]
Gilberto Gandelman Oct. 1990 32 p In PORTUGUESE; ENGLISH summary
(INPE-5166-RPE/637) Avail: NTIS HC/MF A03

The modeling and parameter estimation of drift in inertial sensors is discussed. The model includes constant drift, ramp effects, white noise (short-term random drift), and random walk (long-term random drift). The estimation is based on two different procedures. The first is achieved by a recursive formulation of the least squares method, which estimates the stochastic parameters. The second employs the usual formulation of the least squares method for the estimation of deterministic parameters. Digital simulation provides the validation of the proposed method. The algorithm can also be used with test data. Author

N91-21747# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
UTILIZATION OF GPIOP IN THE MATRIX PROCESSOR FPS-5410 [UTILIZACAO DO GPIOP NO PROCESSADOR MATRICIAL FPS - 5410]
Joao BeneditoDiehl and Juan SunePerez Oct. 1990 72 p In PORTUGUESE; ENGLISH summary
(INPE-5152-RPE/634) Avail: NTIS HC/MF A04

The main characteristics of the GPIOP (General Purpose Programmable Input/Output Processor), for use of the VAX-AP-GPIOP system of the Mechanics Dept. are presented. First, an overview of the GPIOP hardware is presented. Then, the software of the GPIOP is presented, with examples of utilization. Author

N91-21748# Argonne National Lab., IL.
AUTOMATED COMPUTER SOFTWARE DEVELOPMENT STANDARDS ENFORCEMENT
H. P. Yule and J. W. Formento 1991 8 p Presented at the 4th Software Engineering Standards Application Workshop, San Diego, 21-23 May 1991
(Contract W-31-109-eng-38)
(DE91-007328; CONF-9105125-1) Avail: NTIS HC/MF A02

The Uniform Development Environment (UDE) is being investigated as a means of enforcing software engineering standards. For the programmer, it provides an environment containing the tools and utilities necessary for orderly and controlled development and maintenance of code according to requirements. In addition, it provides DoD management and developer management the tools needed for all phases of software life cycle management and control, from project planning and management, to code development, configuration management, version control, and change control. This paper reports the status of UDE development and field testing. DOE

N91-21749# Sandia National Labs., Albuquerque, NM.
SIGNAL PARAMETER ALGORITHMS FOR TREND ANALYSIS OF DIGITAL DATA ACQUISITION SYSTEMS
J. W. Lee 1991 5 p Presented at the IEEE Instrumentation/ Measurement Technology Conference, Atlanta, 14-16 May 1991
(Contract DE-AC04-76DP-00789)
(DE91-008171; SAND-90-2550C; CONF-9105135-1) Avail: NTIS HC/MF A01

A set of FORTRAN subroutines are described that calculate a comprehensive set of characterization parameters of any uniformly sampled discrete-time wave-form. The parameters and algorithms are based on IEEE Standard 194-1977, Pulse Terms and Definitions, and IEEE Standard 181-1977, Pulse Measurement and Analysis by Objective Techniques. These subroutines are being used extensively for trend analysis of the performance of digital data acquisition systems in the Nevada Test Site field instrumentation system. The algorithms are designed to be independent of pulse shape and polarity. DOE

N91-21750# Sandia National Labs., Albuquerque, NM.
STABILITY ANALYSIS OF TIME-DEPENDENT TRANSPORT ALGORITHMS
A. Badruzzaman 1991 11 p Presented at the International Topical Meeting on Advances in Mathematics, Computation and Reactor Physics, Pittsburgh, 28 Apr. - 2 May 1991
(Contract DE-AC04-76DP-00789)
(DE91-009170; SAND-90-2437C; CONF-910414-25) Avail: NTIS HC/MF A03

Stability characteristics of conventional finite-difference and the finite-moments algorithms for solving the time-dependent transport equation are analyzed. Relations for the temporal error growth factor are derived for the source-free equation, and the implication of adding a source term is discussed. DOE

N91-21751# Oak Ridge National Lab., TN.
GRESS: A PREPROCESSOR FOR SENSITIVITY STUDIES ON FORTRAN PROGRAMS
J. E. Horwedel 1991 12 p Presented at the Society for Industrial and Applied Mathematics (SIAM) Workshop on Automatic Differentiation of Algorithms: Theory, Implementation, and Application, Breckenridge, 6-8 Jan. 1991
(Contract DE-AC05-84OR-21400)
(DE91-009561; CONF-910189-1) Avail: NTIS HC/MF A03

Sensitivity and uncertainty analyses are necessary components in the evaluation of computer simulation models. The identification of important model parameters is valuable for ascertaining specific data needs and as a first step in a thorough assessment of parameter uncertainties. This report describes an automated procedure for performing a comprehensive sensitivity analysis using computer calculus. The procedure employs an automated system called GRESS that utilizes a precompiler to enhance a FORTRAN computer code by adding derivative-taking capabilities. From a single run of an enhanced model, GRESS calculates and reports normalized sensitivities of selected results with respect to all input data. Benchmark results demonstrate that an automated procedure can be used cheaply and efficiently to perform a comprehensive sensitivity analysis of existing computer models. DOE

N91-21752# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
AN EMPIRICAL EVALUATION OF ANALYTICAL MODELS FOR PARALLEL RELATIONAL DATABASE QUERIES M.S. Thesis
Mark C. Denham Dec. 1990 118 p
(AD-A230813; AFIT/GCS/ENG/90D-02) Avail: NTIS HC/MF A06 CSCL 12/7

This thesis documents the design and implementation of three parallel join algorithms to be used in the verification of analytical models developed by Kearns. Kearns developed a set of analytical models for a variety of relational database queries. These models serve as tools for the design of parallel relational database system. Each of Kearns' models is classified as either single step or multiple step. The single step models reflect queries that require only one operation while the multiple step models reflect queries that require multiple operations. Three parallel join algorithms were implemented based upon Kearns' models. Two are based upon single step join models and one is based upon a multiple step join model. They are implemented on an Intel iPSC/1 parallel computer. The single step join algorithms include the parallel nested-loop join and the bucket (or hash) join. The multiple step algorithm that was implemented is a pipelined version of the bucket join. The results show that within the constraints of the test cases run, the three models are all at least accurate to within about 8.5 percent and they should prove useful in the design of parallel relational database systems. GRA

N91-21753# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
AN OBJECT ORIENTED DESIGN AND IMPLEMENTATION OF THE IDEF(SUB 0) ESSENTIAL MODEL USING Ada AND AN Ada BASED EXPERT SYSTEM M.S. Thesis
Terry L. Kitchen Dec. 1990 173 p
(AD-A230814; AFIT/GCS/ENG/90D-07) Avail: NTIS HC/MF A08 CSCL 12/5

This thesis develops and implements an Ada based object oriented design (OOD) of the IDEF(sub 0) Essential Data Model called the Essential Subsystem, which includes an Ada based expert system for IDEF(sub 0) model syntax checking. IDEF(sub 0) is a graphic approach to system description development by SofTech, Inc. for the U.S. Air Force Program for Integrated Computer Aided Manufacturing (ICAM) and is a subset of the Structured Analysis (SA) language (30, 36). The IDEF(sub 0) Essential Data Model is an entity-relationship (E-R) model of the IDEF(sub 0) language and represents the fundamental (essential) information of an IDEF(sub 0) model. The Essential Subsystem is so named because of its intended use as a subsystem for integration with the Ada based, IDEF(sub 0) CASE tool, SAtool 2, that is under concurrent development. The development of SAtool 2 is part of ongoing research at the Air Force Institute of Technology (AFIT), with the Strategic Defense Initiative Organization (SDIO), on the use of the IDEF(sub 0) as a software requirements modeling methodology. GRA

N91-21754# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
A REMOTE VISUAL INTERFACE TOOL FOR SIMULATION CONTROL AND DISPLAY M.S. Thesis
William J. DeRouchey Dec. 1990 91 p
(AD-A231019; AFIT/GCS/ENG/90D-3) Avail: NTIS HC/MF A05 CSCL 12/5

This thesis discusses the design and development of the Visual Interactive Simulation Interface Tool (VISIT). VISIT was designed to provide the graphical representation and user interface for a simulation that is running on another processor utilizing internet communications. The system provides support for various input devices to control the simulation display and environment. Simulation objects are displayed using either a three-dimensional wireframe representation or a Gouraud shaded representation. Viewer interaction to the simulation is provided by a collection of commands that allow the viewer to initialize, start, stop, abort, and restart the simulations. The viewer also has the ability to establish checkpoints. Upon reaching a checkpoint the viewer can step through the output display and/or manipulate the objects within the simulation. GRA

N91-21755# Air Force Inst. of Tech., Wright-Patterson AFB, OH.
AN OBJECT-ORIENTED MILITARY SIMULATION BASELINE FOR PARALLEL SIMULATION RESEARCH M.S. Thesis
Robert J. Rizza Dec. 1990 196 p
(AD-A231030; AFIT/GCS/ENG/90D-12) Avail: NTIS HC/MF A09 CSCL 12/5

This thesis documents the design and implementation of a discrete event military simulation using a modular object-oriented design and the C programming language. The basis simulation is one of interacting objects. The objects move along a predetermined path until they encounter another object. Objects react to the encounter object according to the implemented algorithm. Object reaction options are fight, evade, or do nothing. In the code's current form it is generic enough to allow a user the flexibility of creating an infinite number of scenarios bounded in size by the hardware's memory capacity. The modularity of design will allow for easy expansion of object complexity and detail, as well as easy removal or replacement of functions or events. The simulation code makes use of a generic linked list data structure and simulation driver. This adds yet another area to the code where expansion, removal, or replacement could be easily accomplished. The net result is a military scenario simulation program which is highly expandable and modifiable, yet compact enough to be easily understood. GRA

N91-21756# Washington State Univ., Pullman.
RAPIDLY CONVERGENT ALGORITHMS FOR NONSMOOTH OPTIMIZATION Final Report, 16 Jun. 1988 - 30 Sep. 1990
Robert Mifflin 1 Dec. 1990 6 p
(Grant AF-AFOSR-0180-88; AF Proj. 2304)
(AD-A231110; AFOSR-90-1220TR) Avail: NTIS HC/MF A02 CSCL 12/4

The research supported by this grant has continued the development of efficient methods for solving optimization problems involving implicitly defined functions that are not everywhere differentiable. Progress has been made on extending a rapidly convergent algorithm for the single variable case to the n variable case. A specialization of this research has produced a new two matrix quasi-Newton method for smooth minimization. Also, a new fast method has been developed for the single variable case where only function, and not subderivative, values are available. GRA

N91-21757# Stanford Univ., CA.
COMPUTER AIDED DESIGN TOOLS AND ALGORITHMS FOR SUBMICRON TECHNOLOGIES Final Report, 1 Jul. 1987 - 30 Jun. 1990
Robert W. Dutton 23 Oct. 1990 13 p
(Contract DAAL03-87-K-0077)
(AD-A231171; ARO-24863.13-EL) Avail: NTIS HC/MF A03 CSCL 09/1

Advanced algorithms for two and three dimensional modeling of semiconductor devices have been developed, implemented on parallel computers and tested using several high performance technologies. Computational limitations for semiconductor device analysis have been extended to greater than 100000 nodes and speedup factors greater than 10-fold have been realized using distributed memory (MIMD) architectures. Two classes of algorithms have been explored using parallel processing-distributed multifrontal (DMF) and Monte Carlo (MC). The DMF algorithm has been implemented and tested for 3D device analysis of MOS, bipolar and latchup examples using iterative methods for single- and two-carrier transport. A windowed MC analysis of 2D hot carrier effects in Si MOS and GaAs MESFET devices has been achieved on several parallel architectures with near ideal speedup factors up to 20 processors. Useability of device simulation has been enhanced and demonstrated through applications. The range of technologies that can be modeled with the 2D PISCES program now includes: GaAs, GeSi heterojunctions and photo- and other carrier-generation process. Moreover, layout-driven input 2D/3D output visualization capabilities increase user efficiency. Device and technology scaling applications have been used to evaluate both 2D and 3D device capabilities. BiCMOS scaling issues and new structures have been evaluated using PISCES and mixed-mode (device circuit) capabilities. GRA

N91-21758# INTEL Corp., Beaverton, OR. Supercomputer Systems Div.
HIGH PERFORMANCE COMPUTING FOR LARGE EDDY SIMULATIONS: TODAY AND TOMORROW
Justin Rattner Dec. 1990 8 p
(Contract N00014-90-J-4120)
(AD-A231220) Avail: NTIS HC/MF A02 CSCL 20/4

Turbulence, said to be the last unsolved problem in classical physics, is among the most important areas of research facing scientists and engineers today. The study of turbulence is essential to many of the grand challenges of science identified by the Federal High Performance Computing Program. Grand challenge problems such as understanding global environmental change, designing efficient combustion systems and developing controlled nuclear fusion all require the ability to simulate turbulence realistically. The economic impact of turbulence studies affects industries ranging from aerospace and automotive engineering to oil, medicine and electronics. Turbulence studies, including large eddy simulations, are also among the most computationally demanding research areas. The study of vehicle signature calls for sustained

performance in the 10 GigaFLOPS range, and problems such as vehicle dynamics, ocean circulation, viscous fluid dynamics and climate modeling will require sustained performance of a TeraFLOPS (one trillion floating point operations/second). Lacking these levels of performance, LES researchers are forced to parameterize their simulations, reducing a simulation's complexity to fit the available computational power. GRA

N91-21759# Cornell Univ., Ithaca, NY.
FAST ALGORITHMS FOR SIGNAL PROCESSING Final Report, 1 Jul. 1986 - 31 Aug. 1990
Franklin T. Luk Nov. 1990 5 p
(Contract DAAL03-86-K-0109)
(AD-A231226; ARO-24372.1-MA-SDI) Avail: NTIS HC/MF A01 CSCL 09/1

Research in the area of matrix-based signal processing included matrix theory, numerical and parallel computing, signal processing and a Very Large Scale Integration implementation. Results of the research are summarized in the final report with details in the publications and proceedings issued during the course of the research. GRA

N91-21760# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
GRAPHICAL REPRESENTATION OF PARALLEL ALGORITHMIC PROCESSES M.S. Thesis
Edward M. Williams Dec. 1990 248 p
(AD-A231258; AFIT/GCE/ENG/90D-07) Avail: NTIS HC/MF A11 CSCL 12/5

Algorithm animation is a visualization method used to enhance understanding of functioning of an algorithm or program. Visualization is used for many purposes, including education, algorithm research, performance analysis, and program debugging. This research applies algorithm animation techniques to programs developed for parallel architectures, with specific emphasis on the Intel iPSC/2 hypercube. While both P-time and NP-time algorithms can potentially benefit from using visualization techniques, the set of NP-complete problems provides fertile ground for developing parallel applications, since the combinatoric nature of the problems makes finding the optimum solution impractical. The primary goals for this visualization system are: Data should be displayed as it is generated. The interface to the target program should be transparent, allowing the animation of existing programs. Flexibility - the system should be able to animate any algorithm. The resulting system incorporates and extends two AFIT products: the AFIT Algorithm Animation Research Facility (AAARF) and the Parallel Resource Analysis Software Environment (PRASE). AAARF is an algorithm animation system developed primarily for sequential programs, but is easily adaptable for use with parallel programs. PRASE is an instrumentation package that extracts system performance data from programs on the Intel hypercubes. GRA

N91-21761# Wright Research Development Center, Wright-Patterson AFB, OH.
VHSIC HARDWARE DESCRIPTION LANGUAGE (VHDL) BENCHMARK SUITE Final Report, Nov. 1989 - Oct. 1990
Karen M. Serafino and Michael A. Dukes Oct. 1990 709 p
(AD-A231276; WRDC-TR-90-5026) Avail: NTIS HC/MF A99 CSCL 12/5

Changes and additions are documented which were made to the VHDL Benchmark Suite released in October 1989 (WRDC-TR-89-5046). Each benchmark is designed to test one or more of a set of 71 VHDL language features in terms of the limitations of user's or vendor's system architecture, operating system, and VHDL toolset. These limitations could include CPU time and amount of memory required to simulate a test. Examples of language feature tests are the maximum number of signal declarations allowed in an architecture or the maximum size (number of characters) of a process label. GRA

N91-21762# Army Engineer Waterways Experiment Station, Vicksburg, MS. Information Technology Lab.
SOFTWARE DEVELOPMENT STANDARDS FOR PROJECT COST MANAGEMENT INFORMATION SYSTEM Final Report
Margaret B. Wright Dec. 1990 21 p
(AD-A231282; WES/MP/ITL-90-6) Avail: NTIS HC/MF A03 CSCL 12/5

The U.S. Army Engineer Waterways Experiment Station (WES) Corporate Data Base Project (CDB) is using software engineering methods and a structured approach for development of management information systems. These software engineering methods are implemented on the Project Cost Management Information System (PCMIS) as part of the WES CDB. The standards used are based not only on the structured approach but also on Department of Defense and Military standards. Modifications were made to typical life cycle standards so they apply to a fourth generation language (4GL) based information system being developed in a prototyping environment. Project standards encompass quality assurance, design analysis, development, documentation, testing, screen/report standards, and security. Configuration management (CM) standards are developed, but implementation has proven very difficult in a prototyping environment. CM implementation is planned after successful system testing. The use of standards provides consistency in reporting and is a valuable tool for the assurance of a quality product. GRA

N91-21763# Defence Research Establishment, Ottawa (Ontario).
EXCISION TECHNIQUES IN DIRECT SEQUENCE SPREAD SPECTRUM COMMUNICATION SYSTEMS
Brian W. Kozminchuk Nov. 1990 80 p
(AD-A231290; DREO-1047) Avail: NTIS HC/MF A05 CSCL 17/6

A comprehensive summary is presented of a number of methods used in filtering narrowband jammers and interference out of direct sequence spread spectrum communication systems. The basic concept is presented first followed by a discussion of several analog techniques for interference suppression. Most of the emphasis is on digital adaptive methods, which rely on adaptive filtering algorithms. Many of these algorithms are highlighted. This is followed by a discussion on the research which was conducted in digital excision over the past several years. Two cases based on the author's work are also presented. The first details the performance one can expect from the recursive least squares algorithm when the interferer is a stable tone. An analytical model, which predicts the bit error rate performance for the recursive algorithm under certain conditions, is derived. This model is compared to results obtained from computer simulation, the tracking and filtering capabilities of the block and recursive least square algorithms when the interference is of the FM-type, i.e., a swept tone having a bandwidth which is approximately 20 pct. of the chip rate. Author (GRA)

N91-21764# Research Inst. for Advanced Computer Science, Moffett Field, CA.
NORMALIZED CONVERGENCE RATES FOR THE PSMG METHOD
Paul O. Frederickson and Oliver A. McBryan Oct. 1990 12 p
(AD-A231311; RIACS-TR-90-21) Avail: NTIS HC/MF A03 CSCL 12/6

In a previous paper we have introduced an efficient multiscale PDE solver for massively parallel architectures, which called Parallel Superconvergent Multigrid, or PSMG. Sharp estimates are derives for the normalized work involved in PSMG solution - the number of parallel arithmetic and communication operations required per digit of error reduction. PSMG is shown to provide fourth-order accurate solutions of Poisson type equations at convergence rates of .00165 per single relaxation iteration, and with parallel operation counts per grid level of 5.75 communications and 8.62 computations for each digit of error reduction. It is shown that PSMG requires less than half as many arithmetic and one fifth as many

communication operations, per digit of error reduction, as a parallel standard multigrid algorithm (RBTRB) presented recently by N. Decker. GRA

N91-21765# Stanford Univ., CA. Systems Optimization Lab.
INTERIOR-POINT METHODS FOR CONVEX PROGRAMMING
Florian Jarre Nov. 1990 29 p
(Contract N00014-90-J-1242; NSF DDM-87-15153)
(AD-A231372; SU-SOL-90-16) Avail: NTIS HC/MF A03 CSCL 12/4

This work is concerned with generalized convex programming problems, where the objective and also the constraints belong to a certain class of convex functions. It examines the relationship of two conditions for generalized convex programming--self concordance and a relative Lipschitz condition--and gives an outline for a short and simple analysis of an interior-point method for generalized convex programming. It generalizes ellipsoidal approximations for the feasible set, and in the special case of a nondegenerate linear program it establishes a uniform bound on the condition number of the matrices occurring when the iterates remain near the path of centers. GRA

N91-21766# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
FEATURE MATCHING FOR OBJECT LOCALIZATION IN THE PRESENCE OF UNCERTAINTY
Todd A. Cass May 1990 37 p
(Contracts N00014-86-K-0685; N00014-85-K-0124; DACA76-85-C-0010)
(AD-A231405; AI-M-1133) Avail: NTIS HC/MF A03 CSCL 12/9

The problem is considered of matching model and sensory data features in the presence of geometric uncertainty, for the purpose of object localization and identification. The problem is to construct sets of model feature and sensory data feature pairs that are geometrically consistent given that there is uncertainty in the geometry of the sensory data features. If there is no geometric uncertainty, polynomial time algorithms are possible for feature matching, yet these approaches can fail when there is uncertainty in the geometry of data features. Existing matching and recognition techniques which account for the geometric uncertainty in features either cannot guarantee finding a correct solution, or can construct geometrically consistent sets of feature pairs yet have worst case exponential complexity in terms of the number of features. The major new contribution of this work is to demonstrate a polynomial-time algorithm for constructing sets of geometrically consistent feature pairs given uncertainty in the geometry of data features. It is shown that under a certain model of geometric uncertainty the feature matching problem in the presence of uncertainty is of polynomial complexity. This has important theoretical implications by demonstrating an upper bound on the complexity of the matching problem, and by offering insight into the nature of the matching problem itself. GRA

N91-21767# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
AN EFFICIENT CORRESPONDENCE BASED ALGORITHM FOR 2D AND 3D MODEL BASED RECOGNITION Memorandum Report
Thomas M. Breuel Oct. 1990 24 p
(Contracts DACA76-85-C-0010; N00014-85-K-0124)
(AD-A231406; AI-M-1259) Avail: NTIS HC/MF A03 CSCL 12/9

A polynomial time algorithm (pruned correspondence search, PCS) with good average case performance is presented for solving a wide class of geometric maximal matching problems, including the problem of recognizing 3-D objects from a single two dimensional image. Given two finite sets of geometric features with error bounds and a polynomial time algorithm that determines the feasibility of individual matchings, it finds a maximal matching. The algorithm is based on a pruned depth-first search for correspondences. Pruning is accomplished by representing regions of search space that have already been explored using an adjoint list of correspondences between image and model points. The PCS algorithm is connected with the geometry of the underlying recognition problem only through calls to a verification algorithm. The analysis of the PCS algorithm demonstrates clearly the effects of the various combinatorial and geometric constraints on the complexity of the recognition problem. Efficient verification algorithms, based on a linear representation of location constraints, are given for the case of affine transformations among vector spaces and for the case of rigid 2-D and 3-D transformations with scale. Among the known algorithms that solve the bounded error recognition problem exactly and completely, the PCS algorithm currently has the lowest complexity. Some preliminary experiments suggest that PCS is a practical algorithm. Its similarity to existing correspondence based algorithms means that a number of existing techniques for speedup can be incorporated into PCS to improve its performance. GRA

N91-21768# Air Force Inst. of Tech., Wright-Patterson AFB, OH.
COMPUTING WITH NEURAL NETWORKS: A COMPARISON OF THE MULTI-LAYER PERCEPTRON AND THE HIERARCHICAL PATTERN RECOGNITION NETWORK FOR CLASSIFICATION PROBLEMS M.S. Thesis
Stacey W. Christian 1990 104 p
(AD-A231584; AFIT/CI/CIA-90-129) Avail: NTIS HC/MF A06 CSCL 12/9

Two artificial neural networks are compared in the realm of pattern recognition problems: the Multi-Layer Perception (MLP) using the Back Propagation algorithm for training and the Hierarchical Pattern Recognition Network (HPR). Both systems' architecture, node characteristics, and training algorithms are fully developed. Their decision boundary regions are demonstrated graphically on a series of 2 dimensional 2-class problems. The performance of both networks is tested on the Oxford Alvey Vowel Database and LANL's Stamped Metal Database. Additionally, LeCun's theory of Optimal Brain Damage is applied to the MLP in an attempt to reduce network size. The two case studies demonstrated that both networks perform equally well on real-world applications. The HPR network however, proved to be more advantageous in the realm of practical issues such as processing time, adaptability, memory requirements, and the ability to properly identify non-class data. LeCun's method of Optimal Brain Damage was effective in reducing the network size of the MLP and thus decreasing processing time as well as improving generalization performance. GRA

N91-21769# Colorado State Univ., Fort Collins. Dept. of Mathematics.
CONTINUATION AND BIFURCATION INVESTIGATIONS IN CONSTRAINED OPTIMIZATION Final Report, 1 Dec. 1987 - 30 Nov. 1990
Aubrey B. Poore 30 Nov. 1990 21 p
(Grant AF-AFOSR-0059-88; AF Proj. 2304)
(AD-A231639; AFOSR-91-0035TR) Avail: NTIS HC/MF A03 CSCL 12/4

This report describes some of the problems, achievements, and directions of investigation of three areas of research. The first is the investigation of parametric nonlinear programming problems using numerical bifurcation and continuation methods and with applications to design optimization and parametric control systems. The second part centers on investigation of various numerical methods for the solution of nonlinear optimal control problems. The analysis of convergence in infinite dimensional spaces, discretizations, and numerical implementations are in progress for Newton's, penalty, augmented Lagrangian, and interior point methods. The third part of this research program is the development of combinatorial optimization techniques to solve the central problem of multi-target tracking, i.e., the data association problem of partitioning observations into tracks and false alarms. The problem formulation, algorithm design, and real time solution involve techniques from probability and information theory, system identification, filtering, control systems, combinatorial optimization,

and advanced computer architectures, including massively parallel computers. GRA

N91-21064*# Massachusetts Inst. of Tech., Cambridge.
GENERATION AND USE OF UNSTRUCTURED GRIDS FOR TURBOMACHINERY CALCULATIONS
Dana R. Lindquist and Michael B. Giles *In* NASA, Lewis Research Center, Computational Fluid Dynamics Symposium on Aeropropulsion Jan. 1991 p 11-27 Original contains color illustrations (For primary document see N91-21062 13-02)
Avail: NTIS HC/MF A99; 10 functional color pages CSCL 09B

N91-21065*# Rockwell International Science Center, Thousand Oaks, CA.
UNSTRUCTURED GRID GENERATION USING THE DISTANCE FUNCTION
Barna L. Bihari and Sukumar R. Chakravarthy *In* NASA, Lewis Research Center, Computational Fluid Dynamics Symposium on Aeropropulsion Jan. 1991 p 29-40 (For primary document see N91-21062 13-02)
Avail: NTIS HC/MF A99; 10 functional color pages CSCL 09B

N91-21388# Fujitsu Ltd., Tokyo (Japan).
THE SOFTWARE SYSTEM ON PARALLEL PROCESSOR FOR COMPUTATIONAL FLUID DYNAMICS
Shin Okada and Moriyuki Takamura *In* National Aerospace Lab., Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics: Prospects of Computational Fluid Dynamics and Super Computers in Aerospace Science and Technology Sep. 1990 p 109-116 In JAPANESE; ENGLISH summary (For primary document see N91-21379 13-31)
Avail: NTIS HC/MF A06

N91-21783*# University of West Florida, Pensacola. Div. of Computer Science.
SELF-ORGANIZATION AND CLUSTERING ALGORITHMS
James C. Bezdek *In* NASA, Lyndon B. Johnson Space Center, Proceedings of the 2nd Joint Technology Workshop on Neural Networks and Fuzzy Logic, Volume 1 Feb. 1991 p 143-158 (For primary document see N91-21778 13-63)
(Grant NSF IRI-90-03252)
Avail: NTIS HC/MF A11 CSCL 09B

N91-21942*# Hudson Products Corp., NY.
ENGINEERING SOFTWARE DEVELOPMENT WITH HYPERCARD
Robert J. Darko *In* Houston Univ., SEPEC Conference Proceedings: Hypermedia and Information Reconstruction. Aerospace Applications and Research Directions 1990 9 p (For primary document see N91-21940 13-82)
Avail: NTIS HC/MF A08 CSCL 09B

N91-21957*# Microelectronics and Computer Technology Corp., Austin, TX.
AIGERM: A LOGIC PROGRAMMING FRONT END FOR GERM
Safaa H. Hashim *In* Houston Univ., SEPEC Conference Proceedings: Hypermedia and Information Reconstruction. Aerospace Applications and Research Directions. Addendum 1990 18 p (For primary document see N91-21955 13-82)
Avail: NTIS HC/MF A05 CSCL 09B

N91-21958*# Bell Communications Research, Inc., Piscataway, NJ.
HEAVENS SYSTEM FOR SOFTWARE ARTIFACTS
Paul Matthews *In* Houston Univ., SEPEC Conference Proceedings: Hypermedia and Information Reconstruction. Aerospace Applications and Research Directions. Addendum 1990 15 p (For primary document see N91-21955 13-82)
Avail: NTIS HC/MF A05 CSCL 09B

62 COMPUTER SYSTEMS

Includes computer networks and special application computer systems.

N91-21770*# Cornell Univ., Ithaca, NY. Dept. of Computer Science.
TOOLS FOR MONITORING AND CONTROLLING DISTRIBUTED APPLICATIONS
Keith Marzullo and Mark D. Wood Feb. 1991 17 p Sponsored in part by GTE Graduate Student Fellowship
(Contract NAG2-593; N00140-87-C-8904)
(NASA-CR-188034; NAS 1.26:188034; TR-91-1187) Avail: NTIS HC/MF A03 CSCL 09B

The Meta system is a UNIX-based toolkit that assists in the construction of reliable reactive systems, such as distributed monitoring and debugging systems, tool integration systems and reliable distributed applications. Meta provides mechanisms for instrumenting a distributed application and the environment in which it executes, and Meta supplies a service that can be used to monitor and control such an instrumented application. The Meta toolkit is built on top of the Isis toolkit; they can be used together in order to built fault tolerant and adaptive distributed applications. Author

N91-21771# ParaSoft Corp., Pasadena, CA.
AN AUTOMATIC PARALLELIZATION TOOL FOR SEQUENTIAL PROGRAMS Progress Report
Jon W. Flower and Adam Kolawa 25 Oct. 1990 16 p
(Contract N00014-90-C-0141)
(AD-A229972) Avail: NTIS HC/MF A03 CSCL 12/5

In this project a system called ASPAR-the automatic, symbolic parallelization system is being improved. This is a software tool designed to automate the process of converting sequential C and FORTRAN programs for execution on parallel computers. The strategy, as developed in internal research is to modify sequential programs by the addition of calls to the Express runtime library. This is a set of library utilities specifically designed to allow parallel programs to operate in a manner independent of the underlying hardware. A set of abstractions is provided in which the physical machine topology can be hidden by a programming interface in which the machine interconnections can be assumed to match the topology of the data being manipulated. This ability is of central importance to our automated techniques: multi-dimensional arrays can be mapped logically onto a similarly multi-dimensional parallel processing network regardless of that machine physical interconnectivity. A second important advantage of Express is its portability. Express programs can be executed on a wide range of different parallel processing systems including nCUBE and INTEL hypercubes, multi-headed Crays, transputer arrays and networks of UNIX workstations. This allows testing of the methods on many different parallel architectures rather than concentrating on a single type of system. As a result the tools will be of wide relevance in the parallel processing community. GRA

N91-21772# ParaSoft Corp., Pasadena, CA.
A HETEROGENEOUS PARALLEL PROGRAMMING CAPABILITY Final Report
Jon W. Flower and Adam Kolawa 30 Nov. 1990 39 p
(Contract N00014-90-C-0179)
(AD-A229710) Avail: NTIS HC/MF A03 CSCL 12/5

In creating a heterogeneous parallel processing capability we are really trying to approach three basic problems with current systems: (1) Supercomputer and parallel computer hardware architectures vary widely but need to support one or two fairly standard programming languages and programming models. A particularly important issue concerns the short life cycle of individual hardware designs. (2) Many algorithms require capabilities beyond the reach of single superconducters but could be approached by several machines working together. (3) Performing a given task requires integration of a system that may contain many components in addition to the super or parallel computer itself. Peripherals from many different manufacturers must be incorporated. GRA

N91-21773# Sandia National Labs., Albuquerque, NM.
STRUCTURAL ANALYSIS ON MASSIVELY PARALLEL COMPUTERS
C. T. Vaughan 1991 15 p Presented at the Meeting on Parallel Methods on Large-Scale Structural Analysis and Physics Applications, Hampton, 5-6 Feb. 1991
(Contract DE-AC04-76DP-00789)
(DE91-009038; SAND-90-1706C; CONF-910207-3) Avail: NTIS HC/MF A03

An implementation is presented for JAC3D on two massively parallel hypercube computers. JAC3D, a three dimensional finite element code developed at Sandia, uses several hundred hours of Cray time each year in solving structural analysis problems. Two major areas of investigation are discussed: (1) the development of general methods, data structures, and routines to communicate information between processors, and (2) the implementation and evaluation of four algorithms to map problems onto the node processors of the hypercube in a load-balanced fashion. The performance of JAC3D on a 1024-processor NCUBE 2 and NCUBE/ten hypercubes is compared with that on a Cray X-MP: the NCUBE 2 version presently takes 20 percent of the compute time of a Cray processor. DOE

N91-21774# Oak Ridge National Lab., TN.
HYPERCUBE CLOCK SYNCHRONIZATION
T. H. Dunigan Mar. 1991 15 p
(Contract DE-AC05-84OR-21400)
(DE91-009222; ORNL/TM-11744) Avail: NTIS HC/MF A03

Algorithms for synchronizing the times and frequencies of the clocks of Intel and Ncube hypercube multiprocessors are presented. Bounds for the error in estimating clock offsets and frequencies are formulated in terms of the clock read error and message transmission time. Clock and communication performance of the Ncube and Intel hypercubes are analyzed, and performance of the synchronization algorithms is presented. DOE

N91-21775# Massachusetts Inst. of Tech., Cambridge. Lab. for Computer Science.
ON THE MASSIVELY PARALLEL SOLUTION OF THE ASSIGNMENT PROBLEM
Joel Wein and Stavros Zenios Dec. 1990 26 p Prepared in cooperation with Pennsylvania Univ., Philadelphia
(Contract N00014-89-J-1988; AF-AFOSR-0078-86)
(AD-A230847; MIT/LCS/TM-438) Avail: NTIS HC/MF A03
CSCL 12/6

The design, implementation and effectiveness of massively parallel algorithms for the solution of large-scale assignment problems are discussed. In particular, the auction algorithms of Bertsekas, an algorithm based on the method of multipliers of Hestenes and Powell, and an algorithm based on the alternating direction method of multipliers of Eckstein are studied. Alternative approaches to the massively parallel implementation of the auction algorithm, including Jacobi, Gauss-Seidel and a hybrid scheme are discussed. The hybrid scheme, in particular, exploits two different levels of parallelism and an efficient way of communicating the data between them without the need to perform general router operations across the hypercube network. Then the performance of massively parallel implementations of two methods of multipliers was studied. Implementations are carried out on the Connection Machine CM-2, and the algorithms are evaluated empirically with the solution of large scale problems. The hybrid scheme significantly outperforms all of the other methods and gives the best computational results to date for a massively parallel solution to this problem. GRA

N91-21386# Nippon Electric Co. Ltd., Tokyo (Japan).
PARALLELIZATION TECHNIQUES FOR A SUPERCOMPUTER WITH HIERARCHICAL MEMORY ARCHITECTURE
Noriyuki Ando and Naoki Nishi *In* National Aerospace Lab., Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics: Prospects of Computational Fluid Dynamics and Super Computers in Aerospace Science and Technology Sep. 1990 p 93-97 In JAPANESE; ENGLISH summary (For primary document see N91-21379 13-31)
Avail: NTIS HC/MF A06

63 CYBERNETICS

Includes feedback and control theory, artificial intelligence, robotics and expert systems.

For related information see also *54 Man/System Technology and Life Support.*

N91-21776*# Houston Univ., Clear Lake, TX. Research Inst. for Computing and Information Systems.
DESIGNING A TRAINING TOOL FOR IMAGING MENTAL MODELS Final Technical Report, Feb. 1989 - May 1990
Christopher J. Dede and Geetha Jayaram Nov. 1990 87 p Sponsored in cooperation with AF Human Resources Lab.
(Contract NCC9-16)
(NASA-CR-187891; NAS 1.26:187891; AFHRL-CR-90-80) Avail: NTIS HC/MF A05 CSCL 09B

The training process can be conceptualized as the student acquiring an evolutionary sequence of classification-problem solving mental models. For example a physician learns (1) classification systems for patient symptoms, diagnostic procedures, diseases, and therapeutic interventions and (2) interrelationships among these classifications (e.g., how to use diagnostic procedures to collect data about a patient's symptoms in order to identify the disease so that therapeutic measures can be taken. This project developed functional specifications for a computer-based tool, Mental Link, that allows the evaluative imaging of such mental models. The fundamental design approach underlying this representational medium is traversal of virtual cognition space. Typically intangible cognitive entities and links among them are visible as a three-dimensional web that represents a knowledge structure. The tool has a high degree of flexibility and customizability to allow extension to other types of uses, such a front-end to an intelligent tutoring system, knowledge base, hypermedia system, or semantic network. Author

N91-21777# International Neural Network Society, Bethesda, MD.
FIRST ANNUAL MEETING OF INTERNATIONAL NEURAL NETWORK SOCIETY Final Report, 1 Aug. 1988 - 31 Jul. 1990
Stephen Grossberg 31 Jul. 1990 68 p Meeting held in Boston, MA, 6-10 Sep. 1988
(Grant AF-AFOSR-0258-88; AF Proj. 2305)
(AD-A230283; AFOSR-90-1178TR) Avail: NTIS HC/MF A04
CSCL 12/9

The 1988 First Annual Meeting of the International Neural Network Society (INNS) brings together over 2,000 academic commercializers, and financiers in an open forum for the advancement of the full spectrum of significant neural network research and development, from biology through technology. Formed in 1987 in response to the extraordinary international interest in neural network research, INNS includes among its founders many of the most distinguished leaders of the field. By Spring, 1988, INNS membership had grown to over 2,000 of the field's most active researchers, from 34 countries and 47 states in the United States. These are the people who will determine the future of this strategic technology. The INNS invites all those interested in the exciting, and rapidly expanding field of neural networks to attend its 1988 Annual Meeting. The meeting included plenary lectures, symposia, contributed oral and poster presentations, tutorials, commercial and publishing exhibits, government agency presentations, and social events. Papers pertain to: Pattern Recognition; Network Analysis; Cognition and Learning; Neurobiology; Speech; Sensory-motor Control and Robotics; Implementations: Optics and VLSI; Applications; Vision; Neurocomputers. GRA

N91-21778*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
PROCEEDINGS OF THE SECOND JOINT TECHNOLOGY WORKSHOP ON NEURAL NETWORKS AND FUZZY LOGIC, VOLUME 1
Robert N. Lea, ed. and James Villarreal, ed. Feb. 1991 240 p Workshop held in Houston, TX, 10-13 Apr. 1990; sponsored by NASA, Washington, NASA. Johnson Space Center, and Houston Univ.
(NASA-CP-10061-Vol-1; S-624-Vol-1; NAS 1.55:10061-Vol-1)
Avail: NTIS HC/MF A11 CSCL 09B

Documented here are papers presented at the Neural Networks and Fuzzy Logic Workshop sponsored by NASA and the University of Houston, Clear Lake. The workshop was held April 11 to 13 at the Johnson Space Flight Center. Technical topics addressed included adaptive systems, learning algorithms, network architectures, vision, robotics, neurobiological connections, speech recognition and synthesis, fuzzy set theory and application, control and dynamics processing, space applications, fuzzy logic and neural network computers, approximate reasoning, and multiobject decision making. For individual titles, see N91-21779 through N91-21788.

N91-21779*# University of Southern California, Los Angeles.
FUZZY ASSOCIATIVE MEMORIES
Bart Kosko *In* NASA, Lyndon B. Johnson Space Center, Proceedings of the 2nd Joint Technology Workshop on Neural Networks and Fuzzy Logic, Volume 1 Feb. 1991 p 3-58 (For primary document see N91-21778 13-63)
Avail: NTIS HC/MF A11 CSCL 09B

Mappings between fuzzy cubes are discussed. This level of abstraction provides a surprising and fruitful alternative to the propositional and predicate-calculas reasoning techniques used in expert systems. It allows one to reason with sets instead of propositions. Discussed here are fuzzy and neural function estimators, neural vs. fuzzy representation of structured knowledge, fuzzy vector-matrix multiplication, and fuzzy associative memory (FAM) system architecture. Author

N91-21780*# California Univ., San Diego.
NEURAL NETWORK REPRESENTATION AND LEARNING OF MAPPINGS AND THEIR DERIVATIVES
Halbert White, Kurt Hornik, Maxwell Stinchcombe, and A. Ronald Gallant *In* NASA, Lyndon B. Johnson Space Center, Proceedings of the 2nd Joint Technology Workshop on Neural Networks and Fuzzy Logic, Volume 1 Feb. 1991 p 59-89 (For primary document see N91-21778 13-63)
Avail: NTIS HC/MF A11 CSCL 09B

Discussed here are recent theorems proving that artificial neural networks are capable of approximating an arbitrary mapping and its derivatives as accurately as desired. This fact forms the basis for further results establishing the learnability of the desired approximations, using results from non-parametric statistics. These results have potential applications in robotics, chaotic dynamics, control, and sensitivity analysis. An example involving learning the transfer function and its derivatives for a chaotic map is discussed. Author

N91-21781*# National Univ. of Singapore. Inst. of Systems Science.
THE SIMPLIFICATION OF FUZZY CONTROL ALGORITHM AND HARDWARE IMPLEMENTATION
Z. Q. Wu, P. Z. Wang, and H. H. Teh *In* NASA, Lyndon B. Johnson Space Center, Proceedings of the 2nd Joint Technology Workshop on Neural Networks and Fuzzy Logic, Volume 1 Feb. 1991 p 95-106 (For primary document see N91-21778 13-63)
Avail: NTIS HC/MF A11 CSCL 09B

The conventional interface composition algorithm of a fuzzy controller is very time and memory consuming. As a result, it is difficult to do real time fuzzy inference, and most fuzzy controllers are realized by look-up tables. Here, researchers derive a simplified algorithm using the defuzzification mean of maximum. This algorithm takes shorter computation time and needs less memory usage, thus making it possible to compute the fuzzy inference on real time and easy to tune the control rules on line. A hardware implementation based on a simplified fuzzy inference algorithm is described. Author

N91-21782*# Brown Univ., Providence, RI. Dept. of Cognitive and Linguistic Sciences.
RADAR SIGNAL CATEGORIZATION USING A NEURAL NETWORK
James A. Anderson, Michael T. Gately, P. Andrew Penz, and Dean R. Collins *In* NASA, Lyndon B. Johnson Space Center, Proceedings of the 2nd Joint Technology Workshop on Neural Networks and Fuzzy Logic, Volume 1 Feb. 1991 p 107-142 Previously announced in IAA as A91-14886 (For primary document see N91-21778 13-63)
(Contracts N00014-86-K-0600; F33615-87-C-1454; NSF BNS-85-18675)
Avail: NTIS HC/MF A11 CSCL 09B

Neural networks were used to analyze a complex simulated radar environment which contains noisy radar pulses generated by many different emitters. The neural network used is an energy minimizing network (the BSB model) which forms energy minima - attractors in the network dynamical system - based on learned input data. The system first determines how many emitters are present (the deinterleaving problem). Pulses from individual simulated emitters give rise to separate stable attractors in the network. Once individual emitters are characterized, it is possible to make tentative identifications of them based on their observed parameters. As a test of this idea, a neural network was used to form a small data base that potentially could make emitter identifications. Author

N91-21783*# University of West Florida, Pensacola. Div. of Computer Science.
SELF-ORGANIZATION AND CLUSTERING ALGORITHMS c61
James C. Bezdek *In* NASA, Lyndon B. Johnson Space Center, Proceedings of the 2nd Joint Technology Workshop on Neural Networks and Fuzzy Logic, Volume 1 Feb. 1991 p 143-158 (For primary document see N91-21778 13-63)
(Grant NSF IRI-90-03252)
Avail: NTIS HC/MF A11 CSCL 09B

Kohonen's feature maps approach to clustering is often likened to the k or c-means clustering algorithms. Here, the author identifies some similarities and differences between the hard and fuzzy c-Means (HCM/FCM) or ISODATA algorithms and Kohonen's self-organizing approach. The author concludes that some differences are significant, but at the same time there may be some important unknown relationships between the two methodologies. Several avenues of research are proposed. Author

N91-21784*# North Carolina Univ., Chapel Hill. Dept. of Computer Science.
SINGLE BOARD SYSTEM FOR FUZZY INFERENCE
James R. Symon and Hiroyuki Watanabe *In* NASA, Lyndon B. Johnson Space Center, Proceedings of the 2nd Joint Technology Workshop on Neural Networks and Fuzzy Logic, Volume 1 Feb. 1991 p 159-167 (For primary document see N91-21778 13-63)
Avail: NTIS HC/MF A11 CSCL 09B

The very large scale integration (VLSI) implementation of a fuzzy logic inference mechanism allows the use of rule-based control and decision making in demanding real-time applications. Researchers designed a full custom VLSI inference engine. The chip was fabricated using CMOS technology. The chip consists of 688,000 transistors of which 476,000 are used for RAM memory. The fuzzy logic inference engine board system incorporates the custom designed integrated circuit into a standard VMEbus environment. The Fuzzy Logic system uses Transistor-Transistor Logic (TTL) parts to provide the interface between the Fuzzy chip and a standard, double height VMEbus backplane, allowing the chip to perform application process control through the VMEbus host. High level C language functions hide details of the hardware

system interface from the applications level programmer. The first version of the board was installed on a robot at Oak Ridge National Laboratory in January of 1990. Author

N91-21785*# Matsushita Electric Industrial Co. Ltd., Moriguchi (Japan). Central Research Lab.

LEARNING CONTROL OF INVERTED PENDULUM SYSTEM BY NEURAL NETWORK DRIVEN FUZZY REASONING: THE LEARNING FUNCTION OF NN-DRIVEN FUZZY REASONING UNDER CHANGES OF REASONING ENVIRONMENT

Isao Hayashi, Hiroyoshi Nomura, and Noboru Wakami *In* NASA, Lyndon B. Johnson Space Center, Proceedings of the 2nd Joint Technology Workshop on Neural Networks and Fuzzy Logic, Volume 1 Feb. 1991 p 169-182 (For primary document see N91-21778 13-63)

Avail: NTIS HC/MF A11 CSCL 09B

Whereas conventional fuzzy reasonings are associated with tuning problems, which are lack of membership functions and inference rule designs, a neural network driven fuzzy reasoning (NDF) capable of determining membership functions by neural network is formulated. In the antecedent parts of the neural network driven fuzzy reasoning, the optimum membership function is determined by a neural network, while in the consequent parts, an amount of control for each rule is determined by other plural neural networks. By introducing an algorithm of neural network driven fuzzy reasoning, inference rules for making a pendulum stand up from its lowest suspended point are determined for verifying the usefulness of the algorithm. Author

N91-21786*# Hosei Univ., Tokyo (Japan). Dept. of Instrument and Control Engineering.

SOLUTION OF INVERSE PROBLEM OF FUZZY RELATIONAL EQUATION BY USING PERCEPTRON MODEL

Kaoru Hirota and Norikazu Ikoma *In* NASA, Lyndon B. Johnson Space Center, Proceedings of the 2nd Joint Technology Workshop on Neural Networks and Fuzzy Logic, Volume 1 Feb. 1991 p 183-198 (For primary document see N91-21778 13-63)

Avail: NTIS HC/MF A11 CSCL 09B

A Max-Min fuzzy system can be regarded as a network of max and min operational elements. Thus, the inverse problem of a fuzzy relational equation is interpreted as an input estimation problem from output values in the corresponding network. An approximate network model of a fuzzy relational system is proposed. An algorithm for obtaining an approximate solution of the system is presented for using a neural network technique. Author

N91-21787*# Missouri Univ., Columbia. Electrical and Computer Engineering.

EXPERIMENTS ON NEURAL NETWORK ARCHITECTURES FOR FUZZY LOGIC

James M. Keller *In* NASA, Lyndon B. Johnson Space Center, Proceedings of the 2nd Joint Technology Workshop on Neural Networks and Fuzzy Logic, Volume 1 Feb. 1991 p 201-216 (For primary document see N91-21778 13-63)

Avail: NTIS HC/MF A11 CSCL 09B

The use of fuzzy logic to model and manage uncertainty in a rule-based system places high computational demands on an inference engine. In an earlier paper, the authors introduced a trainable neural network structure for fuzzy logic. These networks can learn and extrapolate complex relationships between possibility distributions for the antecedents and consequents in the rules. Here, the power of these networks is further explored. The insensitivity of the output to noisy input distributions (which are likely if the clauses are generated from real data) is demonstrated as well as the ability of the networks to internalize multiple conjunctive clause and disjunctive clause rules. Since different rules with the same variables can be encoded in a single network, this approach to fuzzy logic inference provides a natural mechanism for rule conflict resolution. Author

N91-21788*# Texas A&M Univ., College Station. Dept. of Computer Science.

USING FUZZY LOGIC TO INTEGRATE NEURAL NETWORKS AND KNOWLEDGE-BASED SYSTEMS

John Yen *In* NASA, Lyndon B. Johnson Space Center, Proceedings of the 2nd Joint Technology Workshop on Neural Networks and Fuzzy Logic, Volume 1 Feb. 1991 p 217-233 (For primary document see N91-21778 13-63)

Avail: NTIS HC/MF A11 CSCL 09B

Outlined here is a novel hybrid architecture that uses fuzzy logic to integrate neural networks and knowledge-based systems. The author's approach offers important synergistic benefits to neural nets, approximate reasoning, and symbolic processing. Fuzzy inference rules extend symbolic systems with approximate reasoning capabilities, which are used for integrating and interpreting the outputs of neural networks. The symbolic system captures meta-level information about neural networks and defines its interaction with neural networks through a set of control tasks. Fuzzy action rules provide a robust mechanism for recognizing the situations in which neural networks require certain control actions. The neural nets, on the other hand, offer flexible classification and adaptive learning capabilities, which are crucial for dynamic and noisy environments. By combining neural nets and symbolic systems at their system levels through the use of fuzzy logic, the author's approach alleviates current difficulties in reconciling differences between low-level data processing mechanisms of neural nets and artificial intelligence systems. Author

N91-21789*# Houston Univ., Clear Lake, TX. Research Inst. for Computing and Information Systems.

DOCUMENTATION FOR THE TOKEN RING NETWORK SIMULATION SYSTEM

Jeffery H. Peden and Alfred C. Weaver (Virginia Univ., Charlottesville.) Nov. 1990 24 p

(Contract NCC9-16)

(NASA-CR-188093; NAS 1.26:188093) Avail: NTIS HC/MF A03 CSCL 09B

A manual is presented which describes the language features of the Token Ring Network Simulation System. The simulation system is a powerful simulation tool for token ring networks which allows the specification of various Medium Access Control (MAC) layer protocols as well as the specification of various features of upper layer ISO protocols. In addition to these features, it also allows the user to specify message and station classes virtually to any degree of detail desired. The choice of a language instead of an interactive system to specify network parameters was dictated by both flexibility and time considerations. The language was developed specifically for the simulation system, and is very simple. It is also user friendly in that language elements which do not apply to the case at hand are ignored rather than treated as errors. Author

N91-21790*# Houston Univ., Clear Lake, TX. Research Inst. for Computing and Information Systems.

ANALYSIS OF EXHAUSTIVE LIMITED SERVICE FOR TOKEN RING NETWORKS

Jeffery H. Peden (Virginia Univ., Charlottesville.) Oct. 1990 30 p

(Contract NCC9-16)

(NASA-CR-188092; NAS 1.26:188092) Avail: NTIS HC/MF A03 CSCL 09B

Token ring operation is well-understood in the cases of exhaustive, gated, gated limited, and ordinary cyclic service. There is no current data, however, on queueing models for the exhaustive limited service type. This service type differs from the others in that there is a preset maximum (omega) on the number of packets which may be transmitted per token reception, and packets which arrive after token reception may still be transmitted if the preset packet limit has not been reached. Exhaustive limited service is important since it closely approximates a timed token service discipline (the approximation becomes exact if packet lengths are constant). A method for deriving the z-transforms of the distributions

of the number of packets present at both token departure and token arrival for a system using exhaustive limited service is presented. This allows for the derivation of a formula for mean queueing delay and queue lengths. The method is theoretically applicable to any omega. Fortunately, as the value of omega becomes large (typically values on the order of omega = 8 are considered large), the exhaustive limited service discipline closely approximates an exhaustive service discipline. Author

N91-21791*# Houston Univ., Clear Lake, TX. Research Inst. for Computing and Information Systems.
QUEUEING MODELS FOR TOKEN AND SLOTTED RING NETWORKS Thesis
Jeffery H. Peden Sep. 1990 35 p
(Contract NCC9-16)
(NASA-CR-188091; NAS 1.26:188091) Avail: NTIS HC/MF A03 CSCL 09B

Currently the end-to-end delay characteristics of very high speed local area networks are not well understood. The transmission speed of computer networks is increasing, and local area networks especially are finding increasing use in real time systems. Ring networks operation is generally well understood for both token rings and slotted rings. There is, however, a severe lack of queueing models for high layer operation. There are several factors which contribute to the processing delay of a packet, as opposed to the transmission delay, e.g., packet priority, its length, the user load, the processor load, the use of priority preemption, the use of preemption at packet reception, the number of processors, the number of protocol processing layers, the speed of each processor, and queue length limitations. Currently existing medium access queueing models are extended by adding modeling techniques which will handle exhaustive limited service both with and without priority traffic, and modeling capabilities are extended into the upper layers of the OSI model. Some of the model are parameterized solution methods, since it is shown that certain models do not exist as parameterized solutions, but rather as solution methods. Author

N91-21792# Science Applications International Corp., San Diego, CA.
INTELLIGENT ARRAY SYSTEM Final Report
T. C. Bache, J. T. Anderson, D. Baumgardt, S. R. Bratt, and W. E. Farrell Oct. 1990 179 p
(Contract MDA903-87-C-0037)
(AD-A231107; SAIC-90/1437) Avail: NTIS HC/MF A09 CSCL 12/6

This report presents a detailed description of the major product of this project, a computer hardware/software system called the Intelligent Array System (IAS). The IAS processes data from two high-frequency arrays (NORESS and ARCESS) in Norway to detect, locate and identify seismic events. The IAS computers and functions are distributed between the NORSAR Data Anlaysis Center (NDAC) near Oslo and the Center for Seismic Studies (CSS) in Arlington, VA. The IAS modules at NDAC automatically retrieve data from a disk buffer, detect signals, compute signal attributes (amplitude, slowness, azimuth, polarization, etc.), and store them in a commercial relational database management system (DBMS). IAS makes scheduled (e.g., hourly) transfers of the data to separate DBMS at CSS. Arrival of new data automatically initiates a knowledge-based system (KBS) which interprets these data to locate and identify (earthquake, mine blast, etc.) seismic events. This KBS uses general and area-specific seismological knowledge represented in rules and procedures. For each event, unprocessed data segments (e.g., 7 minutes for regional events) are retrieved from NDAC for subsequent display and analyst review. The interactive analysis modules include integrated waveform and map display/manipulation tools for efficient analyst validation or correction of the solutions produced by the automated system. Another KBS compares the analyst and automatic solutions to mark overruled elements of the knowledge base. Performance analysis statistics guide subsequent changes to the knowledge base so it improves with experience. GRA

N91-21793# Illinois Univ., Urbana. Decision and Control Lab.
ADAPTIVE OUTPUT-FEEDBACK CONTROL OF SYSTEMS WITH OUTPUT NONLINEARITIES
I. Kanellakopoulos, P. V. Kokotovic, and A. S. Morse Dec. 1990 40 p Presented at the Grainger Lectures on Foundations of Adaptive Control, Urbana, IL, 28 Sep. - 1 Oct. 1990
(Grants AF-AFOSR-0011-90; NSF ECS-87-15811)
(AD-A231249; UILU-ENG-90-2258; DC-126) Avail: NTIS HC/MF A03 CSCL 09/1

For a class of single-input single-output nonlinear systems with unknown constant parameters, we present a direct model-reference adaptive control scheme, which requires only output, rather than full-state, measurement. The nonlinearities are not required to satisfy any growth conditions. The assumptions on the linear part of the nonlinear system are the same as in the standard adaptive control problem for linear systems, which now appears as a special case of the nonlinear problem solved in this paper. GRA

N91-21794# Carnegie-Mellon Univ., Pittsburgh, PA.
USING ARTIFICIAL INTELLIGENCE TO AID IN THE DEVELOPMENT OF CAUSAL MODELS Final Report, 1 Apr. 1989 - 30 Mar. 1990
Peter Spirtes, Clark Glymour, Richard Scheines, and Steve Sorensen 6 Dec. 1990 49 p
(Contract N00014-89-J-1964; Proj. RM3-3-M-20)
(AD-A231273) Avail: NTIS HC/MF A03 CSCL 12/5

Data analysis that merely fits an empirical covariance matrix or that finds the best least squares linear estimator of a variable is not a reliable guide to judgements about policy, which inevitably involve causal conclusions. A computer program TETRAD II was developed and tested, that accepts as input background knowledge about a causal structure, a covariance matrix, and a sample size, and outputs a set of suggested models compatible with the background knowledge and that explain the data. In tests on simulated data, TETRAD II was able to suggest a set of models that included the correct one 94 pct. of the time. TETRAD II was applied to several data sets supplied by the Naval Personnel Research and Development Center. GRA

64 NUMERICAL ANALYSIS

Includes iteration, difference equations, and numerical approximation.

N91-21795*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
A MULTIBLOCK MULTIGRID THREE-DIMENSIONAL EULER EQUATION SOLVER
Frank E. Cannizzaro, Alaa Elmiligui, N. Duane Melson, and E. vonLavante (Essen Univ., Germany, F.R.) [1990] 12 p
(Grant NAG1-633)
(NASA-TM-103424; NAS 1.15:103424) Avail: NTIS HC/MF A03 CSCL 12A

Current aerodynamic designs are often quite complex (geometrically). Flexible computational tools are needed for the analysis of a wide range of configurations with both internal and external flows. In the past, geometrically dissimilar configurations required different analysis codes with different grid topologies in each. The duplicity of codes can be avoided with the use of a general multiblock formulation which can handle any grid topology. Rather than hard wiring the grid topology into the program, it is instead dictated by input to the program. In this work, the compressible Euler equations, written in a body-fitted finite-volume formulation, are solved using a pseudo-time-marching approach. Two upwind methods (van Leer's flux-vector-splitting and Roe's flux-differencing) were investigated. Two types of explicit solvers (a two-step predictor-corrector and a modified multistage Runge-Kutta) were used with multigrid acceleration to enhance convergence. A multiblock strategy is used to allow greater geometric flexibility. A report on simple explicit upwind schemes for solving compressible flows is included. Author

N91-21796*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
A FULLY GALERKIN METHOD FOR THE RECOVERY OF STIFFNESS AND DAMPING PARAMETERS IN EULER-BERNOULLI BEAM MODELS Final Report
R. C. Smith and K. L. Bowers (Montana State Univ., Bozeman.) Feb. 1991 23 p Presented at the Second Conference on Computation and Control
(Contract NAS1-18605)
(NASA-CR-187517; NAS 1.26:187517; ICASE-91-15) Avail: NTIS HC/MF A03 CSCL 12A

A fully Sinc-Galerkin method for recovering the spatially varying stiffness and damping parameters in Euler-Bernoulli beam models is presented. The forward problems are discretized with a sinc basis in both the spatial and temporal domains thus yielding an approximate solution which converges exponentially and is valid on the infinite time interval. Hence the method avoids the time-stepping which is characteristic of many of the forward schemes which are used in parameter recovery algorithms. Tikhonov regularization is used to stabilize the resulting inverse problem, and the L-curve method for determining an appropriate value of the regularization parameter is briefly discussed. Numerical examples are given which demonstrate the applicability of the method for both individual and simultaneous recovery of the material parameters. Author

N91-21797*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
ASYMPTOTIC INTEGRATION ALGORITHMS FOR NONHOMOGENEOUS, NONLINEAR, FIRST ORDER, ORDINARY DIFFERENTIAL EQUATIONS
K. P. Walker (Engineering Science Software, Inc., Smithfield, RI.) and A. D. Freed Mar. 1991 45 p
(NASA-TM-103793; E-6070; NAS 1.15:103793) Avail: NTIS HC/MF A03 CSCL 12A

New methods for integrating systems of stiff, nonlinear, first order, ordinary differential equations are developed by casting the differential equations into integral form. Nonlinear recursive relations are obtained that allow the solution to a system of equations at time t plus delta t to be obtained in terms of the solution at time t in explicit and implicit forms. Examples of accuracy obtained with the new technique are given by considering systems of nonlinear, first order equations which arise in the study of unified models of viscoplastic behaviors, the spread of the AIDS virus, and predator-prey populations. In general, the new implicit algorithm is unconditionally stable, and has a Jacobian of smaller dimension than that which is acquired by current implicit methods, such as the Euler backward difference algorithm; yet, it gives superior accuracy. The asymptotic explicit and implicit algorithms are suitable for solutions that are of the growing and decaying exponential kinds, respectively, whilst the implicit Euler-Maclaurin algorithm is superior when the solution oscillates, i.e., when there are regions in which both growing and decaying exponential solutions exist. Author

N91-21798# Institute of Nuclear Physics, Krakow (Poland).
INTEGRABLE HAMILTONIAN SYSTEM IN 2N DIMENSIONS
K. Golec-Biernat and T. W. Ruijgrok 1990 13 p
(DE91-619585; INP-1477/PH) Avail: NTIS HC/MF A03

An integrable Hamiltonian system in 2N dimensions is constructed. It describes N interacting particles on a plane. Solutions to the equations of motion are also presented. DOE

N91-21799# Institut Franco-Allemand de Recherches, Saint-Louis (France).
AUTOMATIC PROGRAM CORRECTION OF INTERFEROMETRY QUADRATIC SENSOR ERRORS. APPLICATION TO THE PROCESSING OF SIGNALS FROM A VISAR INTERFEROMETER [CORRECTION AUTOMATIQUE PAR PROGRAMME DES DEFAUTS DE CAPTEURS QUADRATIQUES UTILISES EN INTERFEROMETRIE. APPLICATION AU TRAITEMENT DES SIGNAUX ISSUS D'UN INTERFEROMETRE VISAR]
P. Raymond 23 Nov. 1989 25 p In FRENCH
(ISL-R-127/89; ETN-91-98994) Avail: NTIS HC/MF A03

A method to obtain the errors of gain, offset, and phase of experimental signals from a VISAR interferometer is described, which can be used for any interferometer. As the signals are sinusoidal, the problem is reduced to the resolution of the equation of a conic, which is made by the least squares method. A simple matricial system is obtained, whose matrix is symmetric. A Doppler interferometer with a high time resolution is given as an example. ESA

N91-21800*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
NUMERICAL RECOVERY OF CERTAIN DISCONTINUOUS ELECTRICAL CONDUCTIVITIES Final Report
Kurt Bryan Mar. 1991 29 p Submitted for publication
(Contract NAS1-18605)
(NASA-CR-187543; NAS 1.26:187543; ICASE-91-33) Avail: NTIS HC/MF A03 CSCL 12A

The inverse problem of recovering an electrical conductivity of the form Gamma(x) = 1 + (k-1)(sub Chi(D)) (Chi(D) is the characteristic function of D) on a region omega is a subset of 2-dimensional Euclid space from boundary data is considered, where D is a subset of omega and k is some positive constant. A linearization of the forward problem is formed and used in a least squares output method for approximately solving the inverse problem. Convergence results are proved and some numerical results presented. Author

N91-21801*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
ON ONE-SIDED FILTERS FOR SPECTRAL FOURIER APPROXIMATIONS OF DISCONTINUOUS FUNCTIONS Final Report
Cai Wei, David Gottlieb, and Chi-Wang Shu (Brown Univ., Providence, RI.) Mar. 1991 20 p Submitted for publication
(Contract NAS1-18605; NAG1-1145; NSF ASC-90-05874; NSF DMS-88-10150; AF-AFOSR-0093-90)
(NASA-CR-187541; ICASE-91-31; NAS 1.26:187541) Avail: NTIS HC/MF A03 CSCL 12A

The existence of one-sided filters, for spectral Fourier approximations of discontinuous functions, which can recover spectral accuracy up to discontinuity from one side, was proved. A least square procedure was also used to construct such a filter and test it on several discontinuous functions numerically. Author

N91-21802# Sandia National Labs., Albuquerque, NM.
UNCERTAINTY ESTIMATES FOR DERIVATIVES AND INTERCEPTS
E. L. Clark 1990 11 p Presented at the 37th Annual Technical Meeting and Equipment Exposition of the Institute of Environmental Sciences (IES), San Diego, 6-10 May 1991
(Contract DE-AC04-76DP-00789)
(DE91-004503; SAND-90-2336C; CONF-910531-1) Avail: NTIS HC/MF A03

Straight line least squares fits of experimental data are widely used in the analysis of test results to provide derivatives and intercepts. A method for evaluating the uncertainty in these parameters is described. The method utilizes conventional least squares results and is applicable to experiments where the independent variable is controlled, but not necessarily free of error. A Monte Carlo verification of the method is given. DOE

N91-21803# Argonne National Lab., IL.
FUNCTIONAL SPECIFICATIONS FOR MATHEMATICAL COMPUTATIONS
J. M. Boyle and T. J. Harmer (Queens Univ., Belfast, Northern Ireland) 1991 18 p Presented at the Working Conference on Constructing Programs from Specifications, Pacific Grove, 13-16 May 1991

(Contract W-31-109-eng-38)
(DE91-006002; CONF-9105112-1) Avail: NTIS HC/MF A03

Are functional programs useful for specifying numerical computations. We believe they certainly are, despite the long-established tradition of using procedural languages for such computations. We have prepared a pure functional specification for an algorithm that solves one-dimensional hyperbolic partial differential equations (PDEs). Using automated program transformations, we have derived a FORTRAN program from this specification that executes faster on a CRAY X-MP than does the hand-written FORTRAN implementation of the same algorithm. We discuss the development of the initial specification for the one-dimensional problem and its evolution into a second specification for solving multidimensional hyperbolic PDEs. In this second specification, the dimensionality of the problem is completely parameterized and is given by specifying the set of neighbors of a cell in the grid. Thus, programs can be derived from this specification to solve hyperbolic PDEs of any given dimensionality. Our goal is to elucidate how we approach specifying numerical computations in the functional style and to show how we take advantage of the modularity and abstractness of functional programming to obtain a very high-level representation of the algorithm. We also briefly discuss transformational derivation of efficient programs from such specifications. DOE

N91-21804# Sandia National Labs., Albuquerque, NM.
CHAOTIC AND RANDOM PROCESSES
T. L. Paez 1991 10 p Presented at the 37th Annual Technical Meeting and Equipment Exposition of the Inst. of Environmental Sciences (IES), San Diego, 6-10 May 1991
(Contract DE-AC04-76DP-00789)
(DE91-008574; SAND-91-0401C; CONF-910531-3) Avail: NTIS HC/MF A02

System dynamicists frequently encounter signals they interpret as realizations of normal random processes. To simulate these analytically and in the laboratory they use methods that yield approximately normal random signals. The traditional digital methods for generating such signals have been developed during the past 25 years. During the same period of time much development has been done in the theory of chaotic processes. The conditions under which chaos occurs have been studied, and several measures of the nature of chaotic processes have been developed. Some of the measures used to characterize the nature of dynamic system motions are common to the study of both random vibrations and chaotic processes. This paper considers chaotic processes and random vibrations. It shows contrasts between the two and situations where they are indistinguishable. The applicability of the Central Limit Theorem to chaotic processes is demonstrated. DOE

N91-21805# Oak Ridge National Lab., TN. Mathematical Sciences Section.
THE IBM RISC SYSTEM/6000 AND LINEAR ALGEBRA OPERATIONS
Jack J. Dongarra, Peter Mays, and Guiseppe RadicatidiBrozolo (IBM Italia, Rome.) Jan. 1991 26 p
(Contract DE-AC05-84OR-21400)
(DE91-009221; ORNL/TM-11768) Avail: NTIS HC/MF A03

This paper discusses the IBM RISC System/6000 workstation and a set of experiments with blocked algorithms commonly used in solving problems in numerical linear algebra. We describe the performance of these algorithms and discuss the techniques used in achieving high performance on such an architecture. DOE

N91-21806# Carnegie-Mellon Univ., Pittsburgh, PA.
NUMERICAL ANALYSIS AND COMPUTATION OF NONLINEAR PARTIAL DIFFERENTIAL EQUATIONS FROM APPLIED MATHEMATICS Final Report, 19 Mar. - 31 Aug. 1990
Donald A. French 24 Oct. 1990 4 p
(Contract DAAL03-90-G-0077)
(AD-A231188; ARO-26781.1-MA) Avail: NTIS HC/MF A01 CSCL 12/1

Work which involved both error estimates and computations on a time dependent problem modeling the deformations of a viscoelastic solid was completed during the term of this report. Also two algorithms were derived and implemented for the Kdv equation with wavemaker boundary conditions. GRA

65 STATISTICS AND PROBABILITY

Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

N91-21807# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
NUMERICAL ANALYSIS METHODS. VOLUME 3: AUTOCORRECTION METHODS [ANALISE DE METODOS NUMERICOS - METODOS AUTOCORRETIVOS - VOLUME 3]
C. J. Zamlutti Oct. 1990 124 p In PORTUGUESE; ENGLISH summary
(INPE-5196-MD/45) Avail: NTIS HC/MF A06

Under the denomination of self-correcting methods, a set of methods are collected within the same context for the theory of approximation. The set is characterized by the possibility of refining successively the solutions until a prescribed accuracy is obtained. However, in the methods presented the amount of computational work required to obtain the desired accuracy cannot be predicted. Author

N91-21808# Lawrence Livermore National Lab., CA.
RECENT DEVELOPMENTS IN MONTE CARLO TECHNIQUES
G. B. Zimmerman 28 Nov. 1990 12 p Presented at the 1990 Nuclear Explosives Code Developers' Conferene, Monterey, 6-9 Nov. 1990
(Contract W-7405-eng-48)
(DE91-009750; UCRL-JC-105616; CONF-9011149-15) Avail: NTIS HC/MF A03

Many aspects of the using Monte Carlo methods to transport particles in complex geometries are explored. The thermonuclear source of particles is presented as a Monte Carlo simulation of the reaction process. Corrections due to both bulk and thermal Doppler motion are described as are detailed general purpose formulas for the stopping of charged particles. In heterogeneous materials characterized by binary Markovian statistics models are presented for the effects on both thermal and Monte Carlo transport. It is found that the effects of angular Coulomb scattering must be included in models of charged particle transport through heterogeneous materials. DOE

N91-21809# Stanford Univ., CA. Dept. of Statistics.
ITERATIVE PROCEDURES FOR EXACT MAXIMUM LIKELIHOOD ESTIMATION IN THE FIRST-ORDER GAUSSIAN MOVING AVERAGE MODEL
T. W. Anderson and R. P. Mentz Nov. 1990 62 p
(Contract DAAL03-89-K-0033)
(AD-A230812; SU-TR-25; ARO-26394.4-MA) Avail: NTIS HC/MF A04 CSCL 12/3

Estimation of the parameters of a first-order Gaussian moving average model is treated in detail. Iterative methods in both the time and frequency domains are based on the maximization of the exact likelihood. Several methods for evaluating the necessary quadratic forms and traces are presented. The procedures are compared with other and with alternative procedures. GRA

N91-21810# Stanford Univ., CA. Dept. of Statistics.
BAYESIAN ANALYSIS OF CONSTRAINED PARAMETER AND TRUNCATED DATA PROBLEMS
A. E. Gelfand, A. F. Smith, and T. M. Lee 4 Jan. 1991 34 p
(Contract N00014-89-J-1627)
(AD-A231080; TR-439) Avail: NTIS HC/MF A03 CSCL 12/3

Bayesian analysis of constrained parameter and truncated data problems is complicated by the seeming need for, typically multidimensional, numerical integrations over awkwardly defined regions. This paper illustrates how the Gibbs sampler approach to

Bayesian calculation (Gelfand and Smith, 1990) avoids these difficulties and leads to straightforwardly implemented procedures, even for apparently very complicated model forms. GRA

N91-21811# Naval Postgraduate School, Monterey, CA. Dept. of Operations Research.
CLASSIFICATION OF INTERMITTENT DEPENDENT OBSERVATIONS
Patricia A. Jacobs and Donald P. Gaver Oct. 1990 47 p
(AD-A231605; NPS-OR-91-02) Avail: NTIS HC/MF A03 CSCL 12/3

Each of J items has a characteristic Signature which varies in time. At time 0, the value of a Signature and the identity of the corresponding item are known. No further values of Signatures are observed until a later time T greater than 0. At time t a Signature associated with an unknown item is observed. The problem is to estimate the identity of the item whose Signature is observed at time t. The estimation procedure studied is to estimate the identity of the item that is associated with the Signature at time t to be that one which maximizes the posterior probability of being associated with the observed Signature. Univariate and multivariate Gaussian and univariate Cauchy autoregressive processes are considered as models for the Signatures. The robustness of the univariate Gaussian, (respectively Cauchy), procedure when applied to Cauchy, (respectively Gaussian) data is studied. The results suggest that the Gaussian classification procedure is biased towards classifying the Signature observed at time t as being associated with the same item that is associated with the Signature at time 0. The Cauchy procedure is biased towards classifying a Signature observed at time t as being associated with a different item than the one associated with the Signature at time 0. GRA

66 SYSTEMS ANALYSIS

Includes mathematical modeling; network analysis; and operations research.

N91-21812# Los Alamos National Lab., NM.
REQUIREMENTS FOR PROGRESSIVE STRATEGIC DEFENSES
G. H. Canavan Mar. 1991 42 p
(Contract W-7405-eng-36)
(DE91-008997; LA-11781-MS) Avail: NTIS HC/MF A03

Space-based layers face counter-measures, cost, and survivability concerns. Midcourse defenses face decoys, which they must discriminate. Simple models indicate that their initial deployment should be effective and that development could improve their effectiveness. That would provide a hedge against uncertainty and an incentive to the reduction of offensive forces. DOE

N91-21813# Los Alamos National Lab., NM.
NEAR-TERM BOOST-PHASE DEFENSE SENSITIVITIES
G. H. Canavan Mar. 1991 34 p
(Contract W-7405-eng-36)
(DE91-008999; LA-11859-MS) Avail: NTIS HC/MF A03

Boost-phase defenses are sensitive to offensive and defensive parameters. For distributed silos and mobile heavy missiles, about 25 percent of the weapons should penetrate the boost phase, which would require midcourse defenses. Concentration of heavy mobiles before launch would not impact that. Single-missile mobiles are less attractive targets and should penetrate near-term defenses, but second waves of fixed or compact mobile heavy missiles would be overwhelmed. For nominal costs and performance, combined defenses have adequate margin, but degraded space-based interceptor (SBI) performance or increased sensor costs would eliminate it. Discrimination could keep costs in balance while defending useful numbers of targets. DOE

N91-21814# Los Alamos National Lab., NM.
INTERACTION OF STRATEGIC DEFENSES WITH CRISIS STABILITY
G. H. Canavan Mar. 1991 57 p
(Contract W-7405-eng-36)
(DE91-009002; LA-11919-MS) Avail: NTIS HC/MF A04

Stability indices produce a picture of the transition from offensive to defensive deterrence. Now, fixed intercontinental ballistic missiles (ICBMs) act as a sink; submarine launched ballistic missiles (SLBMs) carry the brunt of retaliation; and aircraft add little. START would shift toward aircraft. Moderate defenses could suppress SLBMs, but would not protect a significant number of ICBMs. Retaliation would shift to aircraft, if protected and penetrating. Combined boost- and mid-course defenses increase stability. Reductions of heavy ICBMs or launch on warning would have little impact. Unilateral defenses change crisis indices little, but reduce delivery. DOE

N91-21815# Lawrence Livermore National Lab., CA.
EFFECTIVENESS OF BOMBER DEPLOYED AUTONOMOUS AIRBORNE VEHICLES IN FINDING RAIL MOBILE SS-24s
A. E. Abey, S. A. Erickson, and P. D. Norquist 1 Aug. 1990 27 p
(Contract W-7405-eng-48)
(DE91-009008; UCRL-ID-105300) Avail: NTIS HC/MF A03

Computer simulation predictions of the effectiveness of autonomous airborne vehicles in finding rail mobile SS-24s are presented. Effectiveness is discussed for several autonomous airborne vehicle endurances and survivabilities for the search area southwest of Moscow. The effect of where the Soviets place the SS-24s on the rail network was also investigated. The simulation predicts significant variations in the ability of a multi-autonomous airborne vehicle system to find SS-24s with these parameters. DOE

N91-21816# Los Alamos National Lab., NM.
STRATEGIC DEFENSE REQUIREMENTS FOR PROGRESSIVE APPLICATIONS
G. H. Canavan and J. C. Browne Mar. 1991 36 p
(Contract W-7405-eng-36)
(DE91-009045; LA-11830-MS) Avail: NTIS HC/MF A03

A companion paper discusses various applications for which strategic defense concepts could be used. The applications form a progression in size and complexity from accidental or unauthorized launches, through third country or subnational threats, to limited or strategic exchanges. This report attempts to quantify the requirements for meeting those applications and to assess the maturity of current strategic defense concepts relative to them, concluding that there are adequate interceptors for all of them, but that sensitivities to uncertainties in discrimination are awkward at all levels and bothersome at the high end. Strategic defenses are applicable to a progression of threats that range from accidental or unauthorized launches, through third country or subnational threats, to limited or strategic exchanges. Technologies exist for long range launches, but launches close to shore are feasible, stressing, and favor the attacker. Space based interceptors are suited to meeting the bulk of the launches; directed energy has significant advantages in reducing the threat to manageable levels. Current interceptor concepts appear adequate, but discrimination is both pivotal and delayed. DOE

N91-21817# Los Alamos National Lab., NM.
THREAT MODERNIZATION IN THE NEAR TERM
G. H. Canavan Mar. 1991 10 p
(Contract W-7405-eng-36)
(DE91-009228; LA-11825-MS) Avail: NTIS HC/MF A02

The continuing effectiveness of space-based interceptors (SBIs) depends critically on the threat modernization rate. Fast-burn missiles could degrade their effectiveness by approximately 50 percent; early deployment of weapons and decoys could degrade it by a like factor, as could reducing the launch area or mobile missile. Together, these factors would reduce SBI availability a

factor of approximately 20 and degrade effectiveness. The result could be a SBI defense that cost as much as the offense. DOE

N91-21818# Los Alamos National Lab., NM.
DISCRIMINATION OPTIONS IN THE NEAR TERM
G. H. Canavan and J. C. Browne Mar. 1991 30 p
(Contract W-7405-eng-36)
(DE91-009000; LA-11829-MS) Avail: NTIS HC/MF A03

The sizes are estimated of midcourse threats for various boost-phase defensive layers, the optimal number of decoys is derived for the offense to use against specified defenses, and the impact is produced of various levels of discrimination on them. An integrated picture is produced of the trades between boost-phase attrition, midcourse defenses, and discrimination. DOE

N91-21819# Los Alamos National Lab., NM.
BACKGROUND ISSUES FOR DEFENSIVE INTERCEPTORS
G. H. Canavan Mar. 1991 10 p
(Contract W-7405-eng-36)
(DE91-009219; LA-12013-MS) Avail: NTIS HC/MF A02

Mean nuclear backgrounds are large, but are arguably amenable to frame-to-frame subtraction. Striated backgrounds on the sensors for defensive interceptors could, however, cause clutter leak-through, which could make detection and tracking difficult. Nominal motions and backgrounds give signal to clutter ratios too low to be useful. Clutter leakage due to line-of-sight drift can be reduced by stabilizing the line of sight around the background clutter itself. Current interceptors have detector arrays large enough for operation independent of nuclear backgrounds in their fields of view. DOE

N91-21820# General Accounting Office, Washington, DC. Information Management and Technology Div.
STRATEGIC DEFENSE SYSTEM: STABLE DESIGN AND ADEQUATE TESTING MUST PRECEDE DECISION TO DEPLOY
Jul. 1990 37 p
(AD-A230864; GAO/IMTEC-90-61) Avail: NTIS HC/MF A03
CSCL 05/1

This report discusses why the Strategic Defense Initiative Organization will not be able to support currently scheduled full-scale development or deployment decisions on any part of Phase 1 of the strategic Defense System. The organization will not be able to support these decisions until it has solidified the system architecture, conducted integrated system-level testing in real-time involving actual pieces of hardware and software, and until the Department of Defense adheres to technical and programmatic oversight, commensurate with such a system. GRA

67 THEORETICAL MATHEMATICS

Includes topology and number theory.

N91-21821# Scientific Research Associates, Inc., Glastonbury, CT.
TRANSPORT VIA MOMENTS OF QUANTUM DISTRIBUTION FUNCTIONS Final Report, 1 Apr. - 30 Sep. 1990
H. L. Grubin and T. R. Govindan 10 Dec. 1990 23 p
(Contract DAAL03-90-C-0005)
(AD-A231182; ARO-27773.1-EL-S) Avail: NTIS HC/MF A03
CSCL 20/10

This study represents the first comprehensive effort to assess through (1) numerical simulations of the equation of motion of the density matrix, and (2) approximate analytical procedures involving an expansion of the Lioville potential, the multiplicative constant associated with the quantum potential as used in quantum hydrodynamic transport. It was found that when quantum effects are corrections to classical calculations, as in N(+)N(-)N(+) structures the factor 1/3' is a satisfactory multiplicative constant. When the quantum potential is no longer a correction, as in the case of double barrier diodes, the multiplicative constant is no longer constant but is position dependent and less than unity. GRA

70 PHYSICS (GENERAL)

For precision time and time interval (PTTI) see *35 Instrumentation and Photography;* for geophysics, astrophysics or solar physics see *46 Geophysics, 90 Astrophysics,* or *92 Solar Physics.*

N91-21822# Moscow State Univ. (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki.
ON THE TEMPERATURE CORRECTIONS FOR QED OPERATORS IN THE SUPERSTRONG MAGNETIC FIELD
A. S. Vshivtsev, Yu. M. Loskutov, and V. V. Skobelev 1990 27 p In RUSSIAN; ENGLISH summary
(DE91-619627; NIIYaF-MGU-90-4-150) Avail: NTIS HC/MF A03

The generalization of quantum electrodynamic two-dimensional approximation in the case of finite temperature is carried out. The temperature contribution to the Green function, the polarization and mass operators, and vertex function are obtained by means of self-time Schwinger-Fock representation and the procedure of temperature introduction. The asymptotic behavior of the obtained expressions are investigated in the high- and low-temperature limits. The Debye charge screening radius for electron gas in the ground state in the strong magnetic field is obtained. It is demonstrated that the temperature correction for the mass operator is negative and can compensate (in the main logarithmic approximation) the electron energy displacement in the magnetic field in the high-temperature limit. It is indicated that the similar situation takes place for the vertex function. DOE

N91-21823# European Space Agency, Paris (France).
NAVIGATION EXPERIMENT NAVEX: MEASUREMENT AND PERFORMANCE OF THE SPACEBORNE CLOCKS
Jens Hannesfahr (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen, Germany, F.R.) Nov. 1990 70 p Transl. into ENGLISH of Navigations Experiment NAVE: Messung und Verhalten der Fluguhren (Oberpfaffenhofen, Fed. Republic of Germany, DLR), 1989 57 p00 Original language document was announced as N90-24580
(ESA-TT-1209; DLR-FB-89-43; ETN-91-98970) Avail: NTIS HC/MF A04

The results of the measurements of the NAVEX flight clocks are described and discussed. The rates of the cesium and the rubidium clock in the onboard equipment of the experiment are determined in each case for individual measuring time intervals, to be precise both for comparisons when the clocks were on the ground and for the phase of the space flight, related in each case to the reference clock on the ground. The calculation of the rates is largely done taking account of the thermal characteristic and of the relativistic effect. The rates during flight and on the ground are compared with one another. Special types of phenomena are discussed. NAVEX showed that commercial atomic clocks can be very well used for space flight even when heavily stressed on the ground before the mission. ESA

N91-21824* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
PERMANENT MAGNET FLUX-BIASED MAGNETIC ACTUATOR WITH FLUX FEEDBACK Patent
Nelson J. Groom, inventor (to NASA) 26 Mar. 1991 7 p Filed 11 Sep. 1989 Supersedes N90-17403 (28 - 9, p 1277)
(NASA-Case-LAR-13785-1; US-Patent-5,003,211;
US-Patent-Appl-SN-405168; US-Patent-Class-310-90.5;
Int-Patent-Class-H02K-7/09) Avail: US Patent and Trademark Office CSCL 20C

The invention is a permanent magnet flux-biased magnetic actuator with flux feedback for adjustably suspending an element on a single axis. The magnetic actuator includes a pair of opposing electromagnets and provides bi-directional forces along the single

axis to the suspended element. Permanent magnets in flux feedback loops from the opposing electromagnets establish a reference permanent magnet flux-bias to linearize the force characteristics of the electromagnets to extend the linear range of the actuator without the need for continuous bias currents in the electromagnets.

Official Gazette of the U.S. Patent and Trademark Office

N91-21825# Sandia National Labs., Livermore, CA.
MEASUREMENT CAPABILITIES OF THE SANDIA, LIVERMORE, STANDARDS LABORATORIES
J. J. Petersen and P. A. Klevgard Feb. 1991 57 p
(Contract DE-AC04-76DR-00789)
(DE91-008124; SAND-90-8254) Avail: NTIS HC/MF A04

The principal measurement services provided by the Sandia, Livermore, Standards Laboratories are summarized and the nominal levels of measurement accuracy that can be provided to a customer are listed. DOE

N91-21826# Sandia National Labs., Albuquerque, NM.
FWP EXECUTIVE SUMMARIES: BASIC ENERGY SCIENCES, MATERIALS SCIENCES PROGRAMS
Jan. 1991 49 p
(Contract DE-AC04-76DP-00789)
(DE91-009223; SAND-91-0169) Avail: NTIS HC/MF A03

Research programs from Sandia Laboratory in Materials Science are briefly presented. Significant accomplishments include: preparation of Tl superconductors under equilibrium conditions; development of force-feedback sensor for interfacial force microscope; predictive model of hydrogen interactions in silicon dioxide on silicon; layer-by-layer sputtering of Si (001); oscillatory As4 surface reaction rates during molecular beam epitaxy of AlAs, GaAs, and InAs; and the effects of interfacial strain on the band offsets of lattice matched III-V semiconductor. Other accomplishments include: a new mechanism for surface diffusion; solid solution effects in Tl-containing superconductors; record high superconducting transitions for organic materials; atomic vibrations in boron carbides; and a method for studying radical/surface reactions in chemical vapor deposition (CVD). Author

71 ACOUSTICS

Includes sound generation, transmission and attenuation. For noise pollution see *45 Environmental Pollution*.

N91-21827*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
THE SOUND OF MOVING BODIES Ph.D. Thesis - Cambridge Univ.
Kenneth Steven Brentner Dec. 1990 113 p Original contains color illustrations
(NASA-TM-103342; NAS 1.15:103342) Avail: NTIS HC/MF A06; 21 functional color pages CSCL 20A

The importance of the quadrupole source term in the Ffowcs, Williams, and Hawkings (FWH) equation was addressed. The quadrupole source contains fundamental components of the complete fluid mechanics problem, which are ignored only at the risk of error. The results made it clear that any application of the acoustic analogy should begin with all of the source terms in the FWH theory. The direct calculation of the acoustic field as part of the complete unsteady fluid mechanics problem using CFD is considered. It was shown that aeroelastic calculation can indeed be made with CFD codes. The results indicate that the acoustic field is the most susceptible component of the computation to numerical error. Therefore, the ability to measure the damping of acoustic waves is absolutely essential both to develop acoustic computations. Essential groundwork for a new approach to the problem of sound generation by moving bodies is presented. This new computational acoustic approach holds the promise of solving many problems hitherto pushed aside. B.G.

N91-21828*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
ACOUSTIC AND AERODYNAMIC STUDY OF A PUSHER-PROPELLER AIRCRAFT MODEL
Paul T. Soderman and W. Clifton Horne Washington Sep. 1990 67 p
(NASA-TP-3040; A-89038; NAS 1.60:3040) Avail: NTIS HC/MF A04 CSCL 20A

An aerodynamic and acoustic study was made of a pusher-propeller aircraft model in the NASA-Ames 7 x 10 ft Wind Tunnel. The test section was changed to operate as an open jet. The 591 mm diameter unswept propeller was operated alone and in the wake of three empennages: an I tail, Y tail, and a V tail. The radiated noise and detailed wake properties were measured. Results indicate that the unsteady blade loading caused by the blade interactions with the wake mean velocity distribution had a strong effect on the harmonics of blade passage noise. The blade passage harmonics above the first were substantially increased in all horizontal directions by the empennage/propeller interaction. Directivity in the plane of the propeller was maximum perpendicular to the blade surface. Increasing the tail loading caused the propeller harmonics to increase 3 to 5 dB for an empennage/propeller spacing of 0.38 mean empennage chords. The interaction noise became weak as empennage propeller spacing was increased beyond 1.0 mean empennage chord lengths. Unlike the mean wake deficit, the wake turbulence had only a small effect on the propeller noise, that effect being a small increase in the broadband noise. Author

N91-21829*# Cornell Univ., Ithaca, NY. School of Mechanical and Aerospace Engineering.
A STUDY OF ROTOR BROADBAND NOISE MECHANISMS AND HELICOPTER TAIL ROTOR NOISE
Shau-Tak Rudy Chou Aug. 1990 188 p
(Grant NAG2-379)
(NASA-CR-177565; A-90269; NAS 1.26:177565) Avail: NTIS HC/MF A09 CSCL 20A

The rotor broadband noise mechanisms considered are the following: (1) lift fluctuation due to turbulence ingestion; (2) boundary layer/trailing edge interaction; (3) tip vortex formation; and (4) turbulent vortex shedding from blunt trailing edge. Predictions show good agreement with available experimental data. The study shows that inflow turbulence is the most important broadband noise source for typical helicopters' main rotors at low- and mid-frequencies. Due to the size difference, isolated helicopter tail rotor broadband noise is not important compared to the much louder main rotor broadband noise. However, the inflow turbulence noise from a tail rotor can be very significant because it is operating in a highly turbulent environment, ingesting wakes from upstream components of the helicopter. The study indicates that the main rotor turbulent wake is the most important source of tail rotor broadband noise. The harmonic noise due to ingestion of main rotor tip vortices is studied. Author

N91-21830# Institut Franco-Allemand de Recherches, Saint-Louis (France).
PROPAGATION OF HELICOPTER NOISE IN THE LOW ATMOSPHERE LAYERS [PROPAGATION DU BRUIT DES HELICOPTERES DANS LES BASSES COUCHES DE L'ATMOSPHERE]
P. Naz and G. Parmentier 23 May 1990 10 p In FRENCH
Presented at the 1st Congres Francais d'Acoustique, Lyon, France, 10-13 Apr. 1990
(ISL-CO-203/90; ETN-91-98981) Avail: NTIS HC/MF A02

The acoustic signatures of several different helicopters, are recorded. For some helicopters, it was observed that noise levels of the characteristic frequencies of the main and back rotor show different attenuations according to the distance between the helicopter and the microphone. The experimental signals show that the acoustic propagation is influenced by the meteorological parameters and their variations. Numerical propagation models based on the wave method are used to simulate the effects of

atmospheric fluctuations on the sound trajectories, which were taken into account with statistic evaluations from random methods. ESA

N91-21831# Institut Franco-Allemand de Recherches, Saint-Louis (France).
CALCULATION OF THICKNESS AND CHARGE NOISE RADIATED BY A ROTOR IN FORWARD FLIGHT [CALCUL DU BRUIT D'EPAISSEUR ET DU BRUIT DE CHARGE RAYONNES PAR UN ROTOR EN VOL D'AVANCEMENT]
J. Haertig and P. Gnemmi 25 Sep. 1989 57 p In FRENCH
(Contract DRET-88/214)
(ISL-R-119/89; ETN-91-98987) Avail: NTIS HC/MF A04

The noise radiated by moving bodies is investigated by establishing the wave equation in a moving area with solid surfaces. By solving this equation, the acoustic pressure radiated in a far field is obtained. The blade vortex interaction noise is calculated by means of aerodynamic data supplied by a three dimensional extension of a two dimensional numerical code of profile/vortex interaction. The calculated acoustic signatures are shown to be in a good agreement with the flow around the rotor. ESA

N91-21832# Institut Franco-Allemand de Recherches, Saint-Louis (France).
BLADE-WAKE INTERACTION ON A TWO BLADE ROTOR WITH PREDICTION OF THE RADIATED NOISE STATIONARY AND FORWARD FLIGHT, COMPARISON BETWEEN CALCULATION, AND EXPERIMENT [INTERACTION PALE/SILLAGE SUR UN ROTOR BIPALE AVEC PREVISION DU BRUIT RAYONNE (VOL STATIONNAIRE ET VOL D'AVANCEMMENT, COMPARAISON CALCUL/EXPERIENCE)]
M. Schaffar, J. Haertig, and F. Gnemmi 23 Oct. 1989 34 p In FRENCH Original contains color illustrations
(ISL-R-120/89; ETN-91-98988) Avail: NTIS HC/MF A03

The method of the vortex networks is applied to the calculation of the flow around a two blade rotor. The obtained results were compared to measured results with a good agreement for the stationary flight. The charges obtained for the forward flight were used to calculate the radiated noise by the Ffowcs-Williams and Hawkings equation. It is concluded that the radiated noise is greatly influenced by the flight conditions and the parameters of the calculation method, such as the coefficients of the Biot and Savert law. ESA

N91-21833# Federal Aviation Administration, Atlantic City, NJ.
COMPARISON OF 14 DECIBELS VERSUS 20 DECIBELS DESIRED TO UNDESIRED SIGNAL PROTECTION RATIOS
Martin Badinelli, Arthur Cushman, and Philip Randazzo Apr. 1991 14 p
(DOT/FAA/CT-TN89/69) Avail: NTIS HC/MF A03

Due to a shortage of very high frequency (VHF) communications frequencies, the FAA must use the same frequencies in different airspaces across the country. The geographical separation between ground transmitters is engineered to provide a desired signal that is at least 14 decibel (dB) above any co-channel signal the receiver may receive. The International Civil Aviation Organization (ICAO) recommends a greater 20-dB separation. This difference between the two signals is known as the desired to undesired (D/U) ratio. Tests performed on eight avionics receivers at the FAA Technical Center to compare receiver performance when exposed to 14- and 20-dB co-channel interference are described. It was concluded that at both D/U ratios, the receiver was able to reproduce clear, audible, and intelligible speech at both D/U ratios. Author

N91-21834*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
FREQUENCY RESPONSE CALIBRATION OF RECESS-MOUNTED PRESSURE TRANSDUCERS
M. A. Marcolini, P. F. Lorber, W. T. Miller, Jr., and A. F. Covino, Jr. (United Technologies Research Center, East Hartford, CT.) Mar. 1991 20 p Presented at the 37th International Instrumentation Symposium, San Diego, CA, 5-9 May 1991
(NASA-TM-104031; NAS 1.15:104031) Avail: NTIS HC/MF A03 CSCL 20A

A technique is described for measuring the frequency response of pressure transducers mounted inside a model, where a narrow pipette leads to an orifice at the surface. An acoustic driver is mounted to a small chamber which has an opening at the opposite end with an O-ring seal to place over the orifice. A 3.18 mm (1/8 inch) reference microphone is mounted to one side of the chamber. The acoustic driver receives an input of white noise, and the transducer and reference microphone outputs are compared to obtain the frequency response of the pressure transducer. Selected results are presented in the form of power spectra for both the transducer and the reference, as well as the amplitude variation and phase shift between the two signals as a function of frequency. The effect of pipette length and the use of this technique for identifying both blocked orifices and faulty transducers are described. Author

N91-21835# Polytechnic Inst. of New York, Farmingdale.
EXPERIMENTAL INVESTIGATION OF SCATTERING OF MAGNETOSTATIC WAVES BY SURFACE ACOUSTIC WAVES
S. M. Hanna, G. P. Murphy (International Business Machines Corp., East Fishkill, NY.), K. Sabetfakhri, and K. Stratakis 1990 4 p Presented at the Ultrasonics Symposium, Honolulu, 5-7 Dec. 1990
(Contract DE-AC02-76CH-00016)
(DE91-009435; BNL-45888; CONF-901202-1) Avail: NTIS HC/MF A01

Single crystal yttrium iron garnet films are known for their low propagation loss for both magnetostatic and acoustic waves. The Bragg scattering was studied of magnetostatic waves off travelling gratings generated by surface acoustic waves. Experimental results for collinear and noncollinear scattering of magnetostatic forward volume waves are reported. For the noncollinear case, scattering of magnetostatic waves at different Bragg angles were studied. The results are in good agreement with the theoretical predictions based on the coupled-mode analysis. DOE

N91-21836# Naval Oceanographic and Atmospheric Research Lab., Bay Saint Louis, MS.
HIGH-FREQUENCY ACOUSTIC SCATTERING Proceedings Report
Robert W. Farwell 1990 9 p
(AD-A230880; NOARL-PR-90-019-240) Avail: NTIS HC/MF A02 CSCL 20/1

Recent high frequency acoustic ocean bottom scattering developments are described. A brief summary of experiments carried out in frequency range from 5 to 180 kHz during the 1980's is presented. These experiments were performed to identify specific scattering mechanisms leading to bottom backscattering, bottom forward loss, and sound penetration into the ocean subbottom. The capability to accurately predict acoustic scattering is addressed through model and data comparisons. Pertinent unresolved issues are discussed. GRA

N91-21837# Naval Oceanographic and Atmospheric Research Lab., Bay Saint Louis, MS.
SCATTERING IN THE TIME DOMAIN FROM SUBMERGED ELASTIC SHELLS AT COINCIDENCE FREQUENCIES
M. F. Werby 1990 5 p
(AD-A231122; NOARL-PR-90-082-221) Avail: NTIS HC/MF A01 CSCL 20/1

It is known that when scattering from elastic shells, a large resonance is produced at frequencies corresponding to values in which the flexural phase velocity is roughly equal to the speed of sound in the fluid. A systematic analysis indicates that the large response is due mainly to water born waves (labeled A waves) which have narrow half-widths and manifest themselves as pronounces spikes in the form function as well as weaker flexural resonances (labeled AO) which have rather larger half-widths and produce an envelope effect due to overlapping resonances over a broad frequency range. These results are analyzed within the context of a new time domain resonance scattering theory and

are shown to produce characteristic transient return signals. From these signals it is possible to calculate both the half-width of the A waves as well as their group velocities. GRA

N91-21838# Naval Oceanographic and Atmospheric Research Lab., Bay Saint Louis, MS.
TRANSIENT SOLUTIONS FROM SCATTERED FIELDS IN A WAVEGUIDE
M. F. Werby 1990 6 p
(AD-A231124; NOARL-PR-90-084-221) Avail: NTIS HC/MF A02 CSCL 20/1

We examine a transient acoustic signal that scatters from a submerged object traversing a waveguide using the object in a waveguide model developed at NOARL. We are concerned with shallow water waveguides using realistic elongated targets. We show how to employ different pulse forms for resonant and nonresonant targets to determine distinguishing characteristics in the pulse signals that scatter from the target via bistatic measurements. Some numerical examples are presented for both frequency and time domain solution. GRA

N91-21839# Texas A&M Univ., College Station. Center for Approximation Theory.
OPTIMAL HANKEL-NORM APPROXIMATION AND RATIONAL FUNCTION MODELS USING IMPULSE RESPONSE DATA Final Report, Jun. 1989 - Jun. 1990
Charles K. Chui 27 Dec. 1990 32 p
(Contract N62190-89-M-1536)
(AD-A231317) Avail: NTIS HC/MF A03 CSCL 20/1

The motivation of this work is rational function modeling of transfer functions using impulse response data from underwater acoustic transducers. However, since such data does not, in general, correspond to a rational model even in the abscence of noise, an effective rational function approximation criterion is necessary. In this report, the approximation error measure used is the Hankel-norm. Approximation using the Hankel-norm is a linear algebra method with an assured global minimum while the usual least-squares approximation is a nonlinear method satisfying only local minimum criteria. There are three outstanding features of this Hankel-norm approach: (1) the rational model is uniquely determined by the optimality criterion; (2) this rational model is guaranteed to be stable; and (3) the exact error approximation is given by a singular value of the corresponding Hankel operator and can be easily computed. The main contribution of this report is to extend Kung's model reduction algorithm to approximating systems not exactly described by rational function models of finite order and to requiring only the solution of simple instead of generalized eigenvalue problems required in Kung's method. GRA

N91-21840# National Center for Physical Acoustics, University, MS.
FY 1989 ACOUSTICS RESEARCH Final Report, 1 Oct. 1988 - 30 Sep. 1990
Lawrence A. Crum 11 Sep. 1990 58 p
(Contract N00014-89-J-1739)
(AD-A231499; NCPA-LC-3-1989) Avail: NTIS HC/MF A04 CSCL 20/1

During FY 89, work was performed in the following nine project areas: (1) bubble related ambient noise in the ocean and bubble clouds and surface reverberation; (2) acoustically active surfaces; (3) acoustic scattering by structures; (4) machinery noise; (5) propagation physics; (6) solid state acoustics; (7) short-range ultrasonic sensing; (8) electro-rheological fluids; and (9) transducer development. GRA

72 ATOMIC AND MOLECULAR PHYSICS

Includes atomic structure, electron properties, and molecular spectra.

N91-21841# Los Alamos National Lab., NM.
RADIATION DOSE CALCULATIONS WITH THE MONTE CARLO METHOD
Hsiao-Hua Hsu 1991 10 p Presented at the 2nd Environmental Radiation Monitoring Technology Symposium, Taiwan (China), 11-14 Mar. 1991
(Contract W-7405-eng-36)
(DE91-008582; LA-UR-91-468; CONF-9103132-1) Avail: NTIS HC/MF A02

For high penetrating radiations such as neutrons and high-energy gamma rays, that deposit their energies uniformly over a large volume of a target medium, the determination of dose is commonly based on calculating the flux and then applying flux-to-dose conversion factors. For charged particles and low-energy gamma and x-rays, their energies are deposited locally, and flux-to-dose conversion factors could be complex functions of medium geometry and source conditions. Using an isotropic beta source, we calculated the doses in water layers (used to simulate tissue), and found that dose values depend on the size and shape of the water cell. We recommend that a standard size and shape of tissue equivalent material be established for beta dose calculations. DOE

N91-21842# Ohio Univ., Athens. Dept. of Physics and Astronomy.
THEORY OF PHOTON AND ELECTRON INDUCED REACTIONS
D. S. Onley and L. E. Wright Feb. 1991 8 p
(Contract DE-FG02-87ER-40370)
(DE91-008993; DOE/ER-40370/3) Avail: NTIS HC/MF A02

During the first seven months of our new grant from the Department of Energy we have made considerable progress on the following aspects of the general investigation of electron and photon induced reactions: (1) photo- and electro-production of mesons; (2) Coulomb distortion effects on (e,e' gamma) and (e,e' p); and (3) studies involving the relativistic shell model. We will report on each of these developments in this paper. DOE

N91-21843# Ohio Univ., Athens. Dept. of Physics and Astronomy.
ELECTRON DISTORTION EFFECTS IN QUASI-ELASTIC ELECTRON SCATTERING Ph.D. Thesis
Yanhe Jin Mar. 1991 163 p
(Contract DE-FG02-87ER-40370)
(DE91-009034; DOE/ER-40370/T3) Avail: NTIS HC/MF A08

This report discusses the following topics: dirac single particle shell model; dirac free states in Coulomb and optical potentials; deep inelastic electron scattering; plane wave born approximation and Rosenbluth separation; analysis of the (sup 40)Ca(e,e(prime)) experimental data; and analysis of the exclusive (e,e(prime)p) experimental data. DOE

N91-21844# California Univ., Berkeley. Lawrence Berkeley Lab.
REVIEW OF CERN HEAVY-ION PHYSICS
J. W. Harris Dec. 1990 25 p Presented at the International Workshop on High Density Nuclear Matter, Ibaraki, Japan, 18-21 Sep. 1990
(Contract DE-AC03-76SF-00098)
(DE91-009326; LBL-30129; CONF-9009339-2) Avail: NTIS HC/MF A03

The primary motivation for studying nucleus-nucleus collisions at very high energies is the possibility of forming a quark-gluon plasma (QGP). In these collisions energy and baryon densities are expected to increase and reach critical values where the quark constituents of the incident nucleons, bound in nuclei, form an extended volume of freely interacting quarks, antiquarks and gluons. Various signatures of the existence of a quark-gluon plasma in these collisions have been proposed: suppression of J/Psi production, an enhancement in strange particle production,

event-by-event fluctuations in the rapidity distributions of produced particles, observation of direct photons from the plasma and other observables. The system is expected to evolve dynamically from a pure plasma or mixed phase through expansion, cooling, hadronization and freeze-out. To be able to determine that a new, transient state of matter has been formed it is necessary not only to identify QGP signatures but also to determine the space-time evolution of the collision process. This requires an understanding of the microscopic structure of hadronic interactions, at the level of quarks and gluons, at high temperatures and high densities. The physical observables important for understanding the dynamics of heavy-ion collisions at high energies and the present status of experimental results covering these observables are described. The various signatures of QGP formation, present experimental results and plausible interpretations of the results are also described. This talk is not meant to be a comprehensive review, it is rather a summary of important background information, current outstanding problems, observations of particular interest and recent results on dynamics and signatures. DOE

N91-21845# Institute of Nuclear Physics, Krakow (Poland).
STRANGE PARTICLES PRODUCTION AND ABSORPTION IN NUCLEI AT HIGH ENERGIES
L. Lesniak and J. Turnau 1989 35 p
(DE91-620399; INP-1475/PH) Avail: NTIS HC/MF A03

The absorption of the secondary hadrons in nuclear matter is studied as a function of their flavor dependent inelastic cross section on nucleons. In particular the ratios K(+)/pi(+) and K(-)/pi(-) of particles produced in the proton-nucleus high energy interactions are examined and described in the very simple phenomenological model. The enhanced production of K9+) mesons is explained by their relatively small interaction. The presence of the initial particle absorption is clearly demonstrated for x(sub F) is greater than 0.5. DOE

N91-21846# Melbourne Univ., Parkville (Australia). School of Physics.
PROCEEDINGS OF THE GORDON CONFERENCE ON PHOTONUCLEAR REACTIONS Ph.D. Thesis
1990 9 p Conference held in Tilton, NH, 6 Aug. 1990
(DE91-621717; UM-P-90/60; CONF-9008184) Avail: NTIS HC/MF A02

This report includes results of cross section measurement of a series of photonuclear reactions carried out by the research team of the School of Physics from Melbourne University using the tagged photon facilities at the Laboratory of Nuclear Research of Tohoku University, Sendai, Japan and the Saskatchewan Accelerator Laboratory of the University of Saskatchewan, Saskatoon, Canada. Planned experiments and a list of the most recent publications are briefly outlined. DOE

N91-21847# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
NUCLEAR RADIATION DETECTORS [DETETORES DE RADIACOES NUCLEARES]
Luiz Alexandre Schuch and Daniel Jean Roger Nordemann Nov. 1990 66 p In PORTUGUESE; ENGLISH summary
(INPE-5090-MD/44) Avail: NTIS HC/MF A04

Detectors of nuclear radiation, such as gaseous detectors, scintillators, and semiconductors, are presented through their general properties and with their operating systems. The semiconductor detectors are studied with more details. Author

N91-21848# Fermi National Accelerator Lab., Batavia, IL.
REVIEW OF NEGATIVE HYDROGEN ION SOURCES
C. W. Schmidt Feb. 1991 6 p Presented at the 1990 Linear Accelerator Conference, Albuquerque, 9-14 Sep. 1990
(Contract DE-AC02-76CH-03000)
(DE91-009461; FNAL/C-91/38; CONF-9009123-66) Avail: NTIS HC/MF A02

In the early seventies, significant discoveries for H(-) ion sources were made at Novosibirsk. These and many improvements which followed have led to useful accelerator sources. With these sources charge-exchange injection into circular accelerators has become desirable and routine. The major developments leading to practical H(-) sources are reviewed. Different types and variations of these sources with some basic physics and operation are described. The operating parameters and beam characteristics of these sources are given. DOE

N91-21849# Toledo Univ., OH. Dept. of Physics and Astronomy.
MEASUREMENTS OF SCATTERING PROCESSES IN NEGATIVE ION-ATOM COLLISIONS
T. J. Kvale 27 Feb. 1991 26 p
(Contract DE-FG05-88ER-13971)
(DE91-009514; DOE/ER-13971/7) Avail: NTIS HC/MF A03

This research project is designed to provide measurements of various scattering processes which occur in H(sup minus) collisions with atomic targets at intermediate energies. The immediate goal is to study elastic scattering, single electron detachment, and target excitation/ionization in H(sup minus) scattering from noble gas targets. For the target inelastic processes, these cross sections are unknown both experimentally and theoretically. The present measurements will provide either experimentally-determined cross sections or set upper limits to those cross sections. In either case, these measurements will be stringent tests of our understanding in energetic negative ion collisions. This series of experiments required the construction of a new facility, and significant progress toward its operation has been realized during this period. The proposed research is described in this report. The progress on and the status of the apparatus is also detailed in this report. DOE

N91-21850# Tennessee Univ., Knoxville. Dept. of Physics.
THE PRODUCTION AND DESTRUCTION OF NEGATIVE IONS
D. J. Pegg 1991 26 p
(Contract DE-FG05-85ER-13456)
(DE91-009517; DOE/ER-13456/31) Avail: NTIS HC/MF A03

During the present grant period we are continuing our measurements of cross sections and asymmetry parameters for single photon-single electron detachment from atomic negative ions. In this period we have studied the stable ions B(sup minus) and Li(sup minus). As a by product of these measurements we have investigated a new technique for measuring electron affinities. As in our previous work, we have made energy- and angle-resolved spectroscopic measurements of the yields and angular distributions of photoelectrons ejected at the intersection of perpendicularly crossed laser and negative ion beams. A combination of measurements of photoelectron yields, which are proportional to differential cross sections, and angular distributions allow us to determine angle-integrated cross sections for the photodetachment process. Cross sections for the inverse process of radiative attachment can be obtained from the photodetachment data by applying the principle of detailed balance. DOE

N91-21851# Illinois Inst. of Tech., Chicago. Dept. of Physics.
THEORETICAL STUDIES IN ELEMENTARY PARTICLE PHYSICS
J. Collins 1990 11 p
(Contract DE-FG02-85ER-40235)
(DE91-009543; DOE/ER-40235/T6) Avail: NTIS HC/MF A03

This report discusses the following topics: Factorization for hard processes in QCD; Sudakov form factors and transverse momentum distributions; Semi-hard processes; otter QCD issues; Cosmic rays from point sources; Higgs and other collider phenomenology; and cosmology. DOE

N91-21852# SRI International Corp., Menlo Park, CA.
THEORETICAL INVESTIGATION OF ENERGY STORAGE IN ATOMIC AND MOLECULAR SYSTEMS: METASTABLE MOLECULAR FUELS Final Report, 15 Aug. 1986 - 15 Aug. 1989
Roberta P. Saxon Dec. 1990 46 p
(Contract F04611-86-C-0070)

(AD-A230854; AL-TR-89-059) Avail: NTIS HC/MF A03 CSCL 21/9

Ion-pair species bound by the coulomb attraction between a stable positive and stable negative ion have been investigated theoretically as candidate high-energy fuels that could form the basis of new propulsion schemes. Theoretical results for H3O, Li3H, and H3F are presented along with specific impulse, I(sub sp), predictions based on calculated energies. The ion-pair local minimum on the first excited potential surface of H3O is found to be unstable with respect to dissociation to H2 + H + O. The ion-pair state of H3F has a double degenerate imaginary frequency. These results support the general conclusion that ion-pair states based on the H3 cation will not be stable because back-charge transfer to H3(+) leads to neutral H3, which is unstable with respect to H2 + H. However, the ion-pair state of Li3H is found to be a local minimum with a very small barrier to conversion to the lower energy planar form. Even the lowest energy form of Li3H as an additive to hydrogen is predicted to provide a 16 percent improvement in I(sub sp). GRA

N91-21853# California Univ., Berkeley. Dept. of Chemistry.
PHOTOELECTRON SPECTROSCOPY OF Si2 Technical Report No. 5, Aug. - Dec. 1990
T. N. Kitsopoulos and D. M. Neumark 15 Jan. 1991 9 p
(Contract N00014-87-K-0495)
(AD-A230911) Avail: NTIS HC/MF A02 CSCL 20/8

The photoelectron spectrum is discussed of Si2 which was obtained at 355 nm. The spectrum shows a series of transition to the low-lying triplet states of Si2 as well as transitions to the higher lying singlet states. Several possible assignments of the anion and neutral triplet states are presented. GRA

N91-21854# Ballistic Research Labs., Aberdeen Proving Ground, MD.
THEORETICAL STUDY OF THE RADIATIVE LIFETIME FOR THE SPIN-FORBIDDEN TRANSITION a3 (SIGMA u +) TO X1 (SIGMA g +) IN He2 Final Report, Sep. 1986 - Jul. 1988
Cary F. Chabalowski, James O. Jensen, David R. Yarkony, and Byron H. Lengsfield, III Dec. 1990 38 p
(AD-A230956; BRL-TR-3184) Avail: NTIS HC/MF A03 CSCL 07/4

The radiative lifetime for the spin-forbidden dipole allowed transition in neutral He2 was calculated. This transition is assumed to derive its intensity by spin-orbit (S-O) induced couplings which are treated using first-order perturbation theory. The first-order corrections to the wavefunctions are calculated directly in the configuration state function (CSF) basis by solving a set of linear equations given by first-order perturbation theory for the perturbation to the zeroth-order wavefunctions. This approach eliminates the need to solve explicitly for many eigenstates of the unperturbed Hamiltonian which would be required if the spectral representation for the perturbed wavefunction were used. The results show a rapidly changing electric transition dipole moment as a function of internuclear separation, R(He-He), over the bound region of a potential energy curve. GRA

N91-21855# Extrel Corp., Pittsburgh, PA.
CONSTRUCTION OF FLOWING AFTERGLOW APPARATUS Final Report, 9 Feb. 1988 - 26 Jun. 1990
S. Dheandhanoo and W. Fite Dec. 1990 19 p
(Contract F04611-88-C-0023)
(AD-A231062; AL-TR-90-028) Avail: NTIS HC/MF A03 CSCL 20/11

The design and construction of a flowing afterglow (FA) apparatus consists of three basic sections: flow tubes, a detection system, and a vacuum/gas handling system. This instrument can be used for gas-phase chemical kinetics studies of both ion-neutral and neutral-neutral reactions. The instrument was designed in a modular manner so that it can be easily assembled for appropriate experiments. A mechanical chopper is added to the system so that modulated molecular beam experiments can be performed. The detection system, which is a Triple Quadrupole Mass Spectrometer, can be used without the flow tubes as an analytical tool. GRA

N91-21856# Texas Univ., Austin. Dept. of Chemical Engineering.
ELECTRON TRANSFER BETWEEN GLUCOSE OXIDASE AND ELECTRODES VIA REDOX MEDIATORS BOUND WITH FLEXIBLE CHAINS TO THE ENZYME SURFACE Technical Report, 1 Jul. 1989 - 1 Jan. 1991
Adam Heller, Wolfgang Schuhmann, Timothy J. Ohara, and Hanns-Ludwig Schmidt 11 Jan. 1991 9 p
(AD-A231115; TR-008) Avail: NTIS HC/MF A02 CSCL 06/1

Electrical communication between redox centers of glucose oxidase and vitreous carbon electrodes is established through binding to oligosaccharides, at the periphery of the enzyme, ferrocene functions pendant on flexible chains. Communication is effective when the chains are long (greater than 10 bonds), but when the chains are short (less than 5 bonds). When attached to long flexible chains the peripherally bound relays penetrate the enzyme to a sufficient depth to reduce the electron transfer distances between a redox center of the enzyme and the relay and between the relay and electrode, thereby increasing the rate of electron transfer. GRA

N91-21857# California Univ., Berkeley. Dept. of Physics.
APPLICATION OF FOURIER-FRESNEL IMAGING TO NEUTRAL-ATOM INTERFEROMETRY
John F. Clauser 3 Oct. 1990 7 p
(Contract N00014-90-J-1475)
(AD-A231154) Avail: NTIS HC/MF A02 CSCL 20/5

This note provides a brief summary of the use of Fourier-Fresnel imaging to neutral atom interferometry. In applications of neutral-atom interferometry not requiring the interferometer to have an open (multiply connected) topology, the use of this imaging has significant advantages, notably ease of alignment, significantly increased through-put flux, ability to work with very short wavelength (and/or high velocity atoms). The results are primarily interesting in that they span the boundary between trapezoidal moire fringes and sinusoidal wave-interference fringes. Their limited applicability, perhaps accounts for the relative obscurity of many of the results to typical curricula of modern-day optics. The emphasis in this note is thus to put existing results (along with some additions that are needed for clarity) in a form suitable for use by techniques available for neutral-atom interferometry. GRA

N91-21858# United Technologies Research Center, East Hartford, CT.
THEORETICAL INVESTIGATION LEADING TO ENERGY STORAGE IN ATOMIC AND MOLECULAR SYSTEMS Final Report, 15 Aug. 1986 - 31 Oct. 1989
H. H. Michels and J. A. Montgomery, Jr. Dec. 1990 120 p
(Contract F04611-86-C-0071)
(AD-A231275; UTRC-927544; WL-TR-89-050) Avail: NTIS HC/MF A06 CSCL 20/10

A theoretical research investigation of light element species, that may have potential for use as advanced propellants or as energy sources in a chemical propulsion system was undertaken. Included in this research program were detailed quantum mechanical studies of the electronic structure of such species, an analysis of their chemical (and thermodynamic) stability and suggestions of possible synthesis routes for their formation and subsequent stabilization. The molecular species that were examined in detail were chosen from those screened to have a predicted theoretical maximum specific impulse in excess of that available from conventional chemical systems. GRA

N91-21859# Northeastern Univ., Boston, MA. Dept. of Chemistry.
CHAOTIC SPECTRA OF SMALL MOLECULES Final Report, 1 Nov. 1987 - 31 Oct. 1990
Michael E. Kellman Dec. 1990 11 p
(Grant AF-AFOSR-0049-88; AF Proj. 2303)

(AD-A231638; AFOSR-91-0034TR) Avail: NTIS HC/MF A03 CSCL 20/5

The goal of this work has been the theoretical analysis of dynamics from highly excited vibrational spectra of polyatomic molecules, especially, of molecules with classically chaotic dynamics. The excitation ranges of these spectra of highly excited molecules present fundamental new problems of spectral analysis which must first be overcome. The foundation for a comprehensive new framework for analyzing spectra in which the dynamics are complicated by strongly interacting degrees of freedom was sought Ideally, this framework will allow for high energy unassignable spectra the kind of detailed level-by-level analysis customary at lower energy. To be really successful, we believe this scheme must be founded in a systematic understanding of the complex underlying classical dynamics of the molecule. GRA

73 NUCLEAR AND HIGH-ENERGY PHYSICS

Includes elementary and nuclear particles; and reactor theory.

For space radiation see *93 Space Radiation.*

N91-21860*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

CORRECTIONS TO THE PARTICIPANT-SPECTATOR MODEL OF HIGH-ENERGY ALPHA-PARTICLE FRAGMENTATION

Francis A. Cucinotta, Lawrence W. Townsend, John W. Wilson, and John W. Norbury (Rider Coll., Lawrenceville, NJ.) Washington May 1991 13 p

(NASA-TM-4262; L-16883; NAS 1.15:4262) Avail: NTIS HC/MF A03 CSCL 20H

The participant-spectator model of nuclear fragmentation is described in terms of pole graphs from direct reaction theory. Corrections to the model for more than one projectile fragment scattering on the target are considered using a triangle graph model. Results for alpha-particle fragmentation at 1 A GeV indicate that corrections to the participant-spectator picture are significant, as indicated by the large interference effects found between the pole and triangle graph terms in the double and single differential cross sections. Author

N91-21861# Mound Lab., Miamisburg, OH.

POST-ENCAPSULATION PLUTONIA REDUCTION FOR GALILEO AND ULYSSES GPHS MODULES: THE MODULE REDUCTION AND MONITORING FACILITY (MRMF)

E. W. Johnson (Lamb Associates, Inc., Rockville, MD.) 1991 8 p Presented at the 8th Symposium on Space Nuclear Power Systems, Albuquerque, NM, 6-10 Jan. 1991

(Contract DE-AC04-88DP-43495)

(DE91-008131; CONF-910116-20) Avail: NTIS HC/MF A02

In heat source systems of the type C/Ir/PuO2, ingrowth of CO and CO2 is evident. This is due to a cyclical reaction between the C and PuO2 constituents. Gas tap results show that repeated exchanges using a pure inert gas backfill reduces the CO/CO2 ingrowth rate. Also, the temperature experienced during Radioisotope Thermoelectric Generator (RTG) processing reduces further the effect such that normal RTG storage temperatures do not result in this deleterious effect. A 36-station vacuum/inert gas manifold has been developed at Mound Facility to serve as a Module Reduction and Monitoring Facility (MRMF) for up to 68 GPHS-type heat source modules. This method of storage effectively prevented atmospheric contamination of modules while reducing the CO/CO2 ingrowth rate. This paper describes in detail the theoretical, practical, facility, and quality/reliability aspects of this processing facility that has supported the Galileo and Ulysses RTG programs. DOE

N91-21862# Los Alamos National Lab., NM.

SUPERCONDUCTING SUPER COLLIDER SILICON TRACKING SUBSYSTEM RESEARCH AND DEVELOPMENT

W. O. Miller, T. C. Thompson, H. J. Ziock, and M. T. Gamble (Massachusetts Inst. of Tech., Cambridge.) Dec. 1990 72 p

(Contract W-7405-eng-36)

(DE91-009227; LA-12029) Avail: NTIS HC/MF A04

The Alamos National Laboratory Mechanical Engineering and Electronics Division has been investigating silicon-based elementary particle tracking device technology as part of the Superconducting Super Collider-sponsored silicon subsystem collaboration. Structural, materials, and thermal issues have been addressed. This paper explores detector structural integrity and stability, including detailed finite element models of the silicon wafer support and predictive methods used in designing with advanced composite materials. The current design comprises a magnesium metal matrix composite (MMC) truss space frame to provide a sparse support structure for the complex array of silicon detectors. This design satisfies the 25 micron structural stability requirement in a 10-Mrad radiation environment. This stability is achieved without exceeding the stringent particle interaction constraints set at 2.5 percent of a radiation length. Materials studies have considered thermal expansion, elastic modulus, resistance to radiation and chemicals, and manufacturability of numerous candidate materials. Based on optimization of these parameters, the MMC space frame will possess a coefficient of thermal expansion (CTE) near zero to avoid thermally induced distortions, whereas the cooling rings, which support the silicon detectors and heat pipe network, will probably be constructed of a graphite/epoxy composite whose CTE is engineered to match that of silicon. Results from radiation, chemical, and static loading tests are compared with analytical predictions and discussed. Electronic thermal loading and its efficient dissipation using heat pipe cooling technology are discussed. Calculations and preliminary designs for a sprayed-on graphite wick structure are presented. A hydrocarbon such as butane appears to be a superior choice of heat pipe working fluid based on cooling, handling, and safety criteria. DOE

N91-21863# Nationaal Inst. voor Kernfysica en Hoge Energiefysica, Amsterdam (Netherlands).

GRID PULSE GENERATOR [ROOSTERPULSER]

P. P. M. Jansweijer and J. T. vanEs 1990 39 p In DUTCH

(DIGEL-1990-6; ETN-91-99051) Avail: NTIS HC/MF A03

A fast pulse generator was designed for the grid of the injector of the electron accelerator MEA in order to shoot the electrons emitted by the cathode into the bundle pipe where they are accelerated. The generator delivers a high voltage pulse of maximum 6000 V with a rise tile smaller than 50 ns. This results in a slow rate of more than 120,000 V/microsecond. A current of 8 A is required to charge the 60 pF capacity of the grid up to 6000 V is 50 ns. The maximul pulse length is 50 microseconds with a 500 Hz pulse repetition frequency. During these 5 microseconds the pulse amplitude stability is better than 0.1 percent. ESA

N91-21864# Fermi National Accelerator Lab., Batavia, IL.

DIFFUSIVE TRANSPORT ENHANCEMENT BY ISOLATED RESONANCES AND DISTRIBUTION TAILS GROWTH IN HADRONIC BEAMS

A. Gerasimov Dec. 1990 22 p Presented at the Particle Accelerator Conference, San Francisco, 6-9 May 1991

(Contract DE-AC02-76CH-03000)

(DE91-006379; FNAL/C-90/250; CONF-910505-1) Avail: NTIS HC/MF A03

The escape rates and evolution of a distribution of particles are considered for a 2-D model of transverse motion of particles in hadronic storage rings, when nonlinear resonances and external diffusion are present. Dynamic enhancement of diffusion inside separatrices can develop under a certain geometry of resonance oscillations and relatively wide resonances, leading to the fast growth of distribution tails and escape rates. The phenomenon is absent in 1-D. DOE

N91-21865# Los Alamos National Lab., NM.

ADVANCED, TIME-RESOLVED IMAGING TECHNIQUES FOR ELECTRON-BEAM CHARACTERIZATIONS

A. H. Lumpkin 1990 54 p Presented at the 1990 Workshop on Accelerator Instrumentation, Batavia, 1-4 Oct. 1990
(Contract W-7405-eng-36)
(DE91-008587; LA-UR-91-532; CONF-9010267-3) Avail: NTIS HC/MF A04

Several unique time-resolved imaging techniques have been developed to address radio frequency (RF)-linac generated electron beams and the free-electron lasers (FEL) driven by such systems. The time structures of these beams involve a series of micropulses with 10 to 15-ps duration, separated by tens of nanoseconds. Mechanisms to convert the e-beam information to optical radiation include optical transition radiation (OTR), Cherenkov radiation, spontaneous emission radiation (SER), and the FEL mechanism itself. The use of gated, intensified television cameras and synchroscan and dual-sweep streak cameras to time-resolve these signals has greatly enhanced the power of these techniques. A brief review of the less familiar conversion mechanisms and electro-optic techniques is followed by a series of specific experimental examples from the RF linac FEL facilities at Los Alamos and Boeing (Seattle, WA). DOE

N91-21866# Central Research Inst. of Electric Power Industry, Tokyo (Japan).
SURVEY ON ELECTRON BEAM PROCESSING TECHNOLOGIES
S. Yasui, K. Sunabe, and T. Inaba Jun. 1990 35 p In JAPANESE; ENGLISH summary
(DE91-759126; CRIE-W-89052) Avail: NTIS HC/MF A03

The developing situation is studied of electron beam processing technologies and the future problems are shown when these are utilized for electric power utilities. When an electron beam is used as a heating source by focussing, the electron beam has features of high focusability, high controllability and high energy density, so that the electron beam is used for parts requiring high quality processing from micro machining, case hardening, and welding to melting furnaces of metals of high melting point. Presently is necessary to hold ultra high voltage for acceleration and high vacuum because of lower current. Since the processing capability with high energy density is high and the energy consumption efficiency is also high for the chemical field using the high energy density of the electron beam, the application are researched in the field from sterilization of medical instruments, sterilization of sludge, through food processing, improvement of thermal resistance of insulated wires to flue gas irradiation to desulfurize and denitrify. But a practical use is not yet realized because of small current of electron beam. Therefore, the largest technological problem may be the development of high current electron gun and the beam control systems. DOE

N91-21867# Stanford Univ., CA. Synchrotron Radiation Lab.
BEAM LINE AND ASSOCIATED WORK Final Report, 1 Feb. 1988 - 30 Sep. 1990
I. Lindau 11 Jan. 1991 5 p
(Contract N00014-88-J-1200)
(AD-A231243) Avail: NTIS HC/MF A01 CSCL 20/7

This is the final report of the operational phase 1988 to 1989 of the DOD supported beam line at the Stanford Synchrotron Radiation Laboratory (SSRL), including an extension to September 1990. SSRL has had very little operating time during this period: The most important technical accomplishment is the complete and successful commissioning of the high resolution monochromator. This means that the entire beam line, i.e., the multi-undulator insertion device, the beam extraction system, the monochromator, and the experimental end station, is now fully operational to the specifications given in the original design. The beam line was used for research in two different programs: (1) electronic properties of molecular beam epitaxially grown semiconductor structures, and (2) diamond technology. GRA

N91-21868# Naval Research Lab., Washington, DC.
STUDIES OF SYNCHROTRON RADIATION EMISSION FROM THE NRL MODIFIED BETATRON ACCELERATOR Interim Report
T. J. Smith, J. Golden, and C. A. Kapetanakos 24 Jan. 1991 31 p
(AD-A231346; NRL-MR-6774) Avail: NTIS HC/MF A03 CSCL 20/8

Numerical calculations of synchrotron radiation emitted from the NRL modified betatron accelerator show that, for relativistic electron energies up to approximately 2 MeV, the single particle intensity spectrum is characterized by a peak at the Doppler-shifted cyclotron frequency associated with applied toroidal field. Measurements of the radiation using fixed-frequency heterodyne receivers indicate that the polarization, amplitude, and the temporal evolution of radiated power during acceleration are in very good agreement with the predicted single particle spectrum. The observations have been used to confirm the energy evolution and provide information about the magnitude of the transverse velocity of the beam electrons for the first few hundred microseconds of acceleration. Late-time signal decay suggests that electrons are moving off the minor axis in a manner that is consistent with the excitation of the electron-cyclotron resonance. GRA

74 OPTICS

Includes light phenomena; and optical devices.
For lasers see *36 Lasers and Masers.*

N91-21869# Harry Diamond Labs., Adelphi, MD.
IMAGE RECOVERY BY SIMULATED ANNEALING Final Report, Aug. 1989 - Dec. 1989
James B. Cole and David H. Gerstman Nov. 1990 11 p
(AD-A230655; HDL-TM-90-21) Avail: NTIS HC/MF A03 CSCL 20/6

The basic problem of image recovery and pattern recognition is to determine the original pattern, f, given its corrupted version, g. The unknown pattern, f, is an element of the set S = f1, f2, f3, and the task is to deduce which pattern in S gave rise to the image data, g. S is called the solution candidate space and could be, for example, the set of alphabetical symbols. If it is known that certain elements of S have a higher probability of occurring than others (such as alphabetical symbols in text), this a priori information can be incorporated into the procedure for finding f according to the techniques of Bayesian analysis. In the general image recovery problem, S is the set of all possible patterns on an n x n pixel image, and the relationship between the original image, f, and the image data, g, can be modeled by g = f + 2, where w is random noise. The set of pixel brightnesses at lattice position (i,j) are described by f = fij, g = gij, and w = wij. Image recovery and pattern recognition problems are thus combinatorial optimization problems, in which a solution candidate space, S, must be searched. The larger S is, the more difficult the search. GRA

N91-21870# North Carolina Univ., Chapel Hill. Dept. of Chemistry.
OPTICAL SWITCHING AND OPTICAL LOGIC IN A THERMALLY EXPANDING Si ETALON Interim Technical Report
S. T. Feng and Eugene A. Irene 6 Dec. 1990 13 p
(Contract N00014-89-J-1178)
(AD-A230706; TR-33) Avail: NTIS HC/MF A03 CSCL 09/3

Optical switching in a thermally expanding Si etalon has been demonstrated. In this experiment a pulsed CO2 laser beam is used to heat a Si etalon and shift the interference fringe of a 1.5 micro probe beam. It is shown that the switching time can be greatly reduced from ms to micron by choosing a probe beam of shorter wavelength in an external switching configuration. By aligning one etalon at switch-on and another at switch-off, a write and erase logic system can be demonstrated. GRA

N91-21871* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
FIBER OPTIC SENSING SYSTEM Patent
Grigory Adamovsky, inventor (to NASA) 26 Feb. 1991 8 p

Filed 7 Sep. 1989 Supersedes N90-15733 (28 - 7, p 992)
(NASA-Case-LEW-14795-1; US-Patent-4,995,697;
US-Patent-Appl-SN-404291; US-Patent-Class-350-96.29;
US-Patent-Class-356-345; US-Patent-Class-250-227;
Int-Patent-Class-G02B-6/02; Int-Patent-Class-G02B-6/16;
Int-Patent-Class-G01B-9/02) Avail: US Patent and Trademark Office CSCL 20F

A fiber optic interferometer utilizes a low coherence light emitting diode (LED) laser as a light source which is filtered and driven at two RF frequencies, high and low, that are specific to the initial length of the resonator chamber. A displacement of a reflecting mirror changes the length traveled by the nonreferencing signal. The low frequency light undergoes destructive interference which reduces the average intensity of the wave while the high frequency light undergoes constructive interference which increases the average intensity of the wave. The ratio of these two intensity measurements is proportional to the displacement incurred. NASA

N91-21872# Sandia National Labs., Albuquerque, NM.
DIP COATING OF SOL-GELS
P. R. Schunk, A. J. Hurd, and C. J. Brinker 1991 4 p Presented at the 44th Annual Conference of the Imaging Science and Technology, St. Paul, 12-17 May 1991
(Contract DE-AC04-76DP-00789)
(DE91-007571; SAND-91-0232C; CONF-9105127-1) Avail: NTIS HC/MF A01

Dip coating is the primary means of depositing sol-gel films for precision optical coatings. Sols are typically multicomponent systems consisting of an inorganic phase dispersed in a solvent mixture, with each component differing in volatility and surface tension. This, together with slow coating speeds (less than 1cm/s), makes analysis of the coating process complicated; unlike most high-speed coating methods, solvent evaporation, evolving rheology, and surface tension gradients alter significantly the fluid mechanics of the deposition stage. These phenomena were studied with computer-aided predictions of the flow and species transport fields. The underlying theory involves mass, momentum, and species transport on a domain of unknown shape, with models and constitutive equations for vapor-liquid equilibria and surface tension. Due accounting is made for the unknown position of the free surface, which locates according to the capillary hydrodynamic forces and solvent loss by evaporation. Predictions of the effects of mass transfer, hydrodynamics, and surface tension gradients on final film thickness are compared with ellipsometry measurements of film thickness on a laboratory pilot coater. Although quantitative agreement is still lacking, both experiment and theory reveal that the film profile near the drying line takes on a parabolic shape. DOE

N91-21873# Brookhaven National Lab., Upton, NY.
PERFORMANCE CHARACTERISTICS OF MACH-ZEHNDER MODULATORS FOR TRANSFER OF DETECTOR SIGNALS BY OPTICAL FIBERS
T. Tsang, V. Radeka, T. Srinivasan-Rao, and W. J. Willis Nov. 1990 9 p Presented at the CLEO '91: Conference on Lasers and Electro-Optics, Baltimore, 12-17 May 1991
(Contract DE-AC02-76CH-00016)
(DE91-008439; BNL-45416; CONF-910595-6) Avail: NTIS HC/MF A02

The results of the preliminary measurements of the optical power requirement, linearity, dynamic range, and noise characteristics of a Mach-Zehnder electro-optical modulator will be presented. The modulator system will be used to minimize the local electronics on a large scale particle detector. DOE

N91-21874# Rochester Univ., NY. Inst. of Optics.
SERRATED CIRCULAR APERTURES: OPTICAL FOURIER TRANSFORMS AND FRACTAL ANALYSIS Ph.D. Thesis
Madeleine M. Beal Sep. 1990 259 p
(Contract DAAL03-86-K-0173)
(AD-A230834; ARO-24626.175-PH-UIR) Avail: NTIS HC/MF A12 CSCL 20/6

The optical transform of the transmission function of a serrated circular aperture is discussed, with particular emphasis on the relationship between the features in the transform and the parameters that describe the aperture serration. The transform is produced in a canonical optical processing system, where the scalar field distribution in the back focal plane of the lens is proportional to the 2-D spatial Fourier transform of the aperture transmission function. In the statistical diffraction theory, the quantity of interest is the two-point moment of the intensity, which is a fourth-order moment of this scalar field component. A careful calculation of the diffracted field is performed. The two-point intensity moment is expanded in terms of second-order moments of the field. Due to the polar symmetry of the field, circularity does not hold and the two significant terms in the expansion are identical but for a rotation. From the detailed expression for the remaining second-order moment, interesting features of the optical transform are extracted. These features are ring fragmentation, the number of transform spikes, and spike appearance, which correspond to serration roughness, correlation angle, and correlation function, respectively. The results of computer simulations and optical experiments support the predicted relationships between the aperture parameters and transform features. GRA

N91-21875# Arizona Univ., Tucson. Optical Sciences Center.
RESEARCH IN OPTICAL SCIENCES Final Report
R. R. Shannon 12 Mar. 1990 119 p Sponsored by ARO, Research Triangle Park, NC
(AD-A230964; ARO-25391.57-PN) Avail: NTIS HC/MF A06 CSCL 17/5

The primary goal of this project is to examine the surface characteristics of mercury cadmium telluride (HgCdTe) infrared detectors to determine the source of performance-limiting dark current in those detectors. This report discusses research progress in the optical sciences, including the areas of scanning tunneling microscopy in the evaluation of HgCdTe material; optical elements for x-ray and uv wavelengths; interaction of a single semiconductor cluster with intense laser beams; coherent and nonlinear effects in semiconductors; nonlinear organics for guided wave devices; nonlinear propagation and wave mixing in sodium vapor; gain/feedback approach to optical instabilities; conical emission; kaleidoscopic spatial instability; nonlinear dynamics and chaos in cavity QED; origin and application of four-wave mixing in semiconductors; theory of the semiconductor laser; nonlinear theory of phase conjugate optics; polishing of diamond films with argon and oxygen ion beams; and chemical vapor deposition of diamond and diamond-like films. GRA

N91-21876# Wisconsin Univ., Madison. Dept. of Electrical and Computer Engineering.
ADAPTIVE DETECTION IN SUBSPACES
Barry D. VanVeen and Chong H. Lee 1990 6 p
(Contract DAAL03-89-K-0141)
(AD-A231023; ARO-26460.6-EL) Avail: NTIS HC/MF A02 CSCL 20/6

This paper considers subspace based adaptive detection in the context of the likelihood ratio test studied by Kelly. The probability of false alarm for this test depends only on the subspace. Thus, we propose choosing the transformation onto the subspace to maximize the probability of detection over a likely class of noise and interference scenarios. An approximate solution to this optimization problem is described. This approach can lead to dramatic increases in the probability of detection given a fixed number of data observations due to a large gain in the statistical stability associated with the reduced dimension subspace. The relationship between subspace design for adaptive detection and partially adaptive beamformer design is explored. Simulations verify the analysis. GRA

N91-21877# Pennsylvania State Univ., University Park. Materials Research Lab.
NEW MATERIALS AND NEW TECHNIQUES FOR IMAGING OF LONG WAVELENGTH IR RADIATION Final Report, 1 Oct. 1987 - 31 Mar. 1990
L. E. Cross 2 Nov. 1990 69 p
(Contract DAAL03-87-K-0152)
(AD-A231086; ARO-25426.3-PH-A) Avail: NTIS HC/MF A04 CSCL 17/5

Work on this program was directed towards the preliminary verification of the possibility of a completely new type of long wavelength infrared imaging system. This study proposed to explore the change in polarized reflectance from the pyro-optic surface, making use of the exceptional sensitivity of the newer ellipsometric techniques for reflectance studies. Cardinal advantages for the pyro-optic reflectance method are the following: (1) thermally sensitive film need only be thick enough to support the evanescent wave on reflection, so that pixel volume (mass) can be exceedingly small; (2) films can be mounted upon a critically dehydrated gel substrate which is transparent to visible light but affords near perfect thermal isolation; (3) there is no need for contacts to individual pixel elements as in the pyroelectric imagers; and (4) calculations show that for a film 0.1 micron meter thick, mounted on a silica gel substrate, the thermal efficiency is such that if the thermometric sensitivity of the film is sufficient to detect a temperature change of 1mK then for a system with f(1) optics this could correspond to a temperature difference in the object plane of 0.1K. The studies on this program were in two parts. The first objective was to verify the high values of temperature derivative of refractive index which has been reported in bismuth vanadate BiVO4, molybdenum MoS2, and antimony sulphur iodide SbSI. The second objective was to design and build a compact thermoelectric heater cooler which could be used to impart a known small AC temperature change to explore the detectivity limit for a pyro-optic application. GRA

N91-21878# Aerospace Corp., El Segundo, CA. Lab. Operations.
TRANSVERSE FLOW GAS LENS
Hal Mirels, Donald J. Spencer, and Robert Hofland 29 Nov. 1990 27 p Previously announced in IAA as A89-42127
(Contract F04701-88-C-0089)
(AD-A231366; TR-0089(4930-06)-1; SSD-TR-90-51) Avail: NTIS HC/MF A03 CSCL 20/6

The concept of a transverse flow gas lens is described. In this device, gas flows between two parallel plates which are heated or cooled so as to generate a parabolic variation of index of refraction in the region between the plates. A laser beam, propagating normal to the gas flow, can then be diverged, converged, or focused. A single module acts like a cylindrical lens. The use of two or three modules, arranged in an orthogonal manner, provides a spherical lens. Equations and tables are provided for the design of one, two, and three module configurations. The advantages of the transverse flow gas lens (relative to a device with flow along the optic axis) are: (1) thermal blooming is minimized (due to short residence time of fluid in laser beam), (2) the index of refraction profile is the same throughout each module, leading to good beam quality, and (3) the system is readily scalable. However, a longer distance along the optical axis may be needed by the transverse flow lens. GRA

N91-21879# University of Southern California, Los Angeles. Center for Laser Studies.
THERMAL TRANSPORT STUDIES OF OPTICAL COATINGS, INTERFACES AND SURFACES BY THERMAL DIFFUSION-WAVE INTERFEROMETRY Final Technical Report, 1 Dec. 1987 - 30 Jun. 1990
Randall T. Swimm 6 Aug. 1990 13 p
(Grant AF-AFOSR-0038-88; AF Proj. 2306)
(AD-A231607; CLS-90-101; AFOSR-91-0027TR) Avail: NTIS HC/MF A03 CSCL 20/6

Thermal diffusion-wave interferometry can produce a wealth of thermal transport information on a single sample. Onset of three-dimensional heat flow, contributions due to thermal contact resistance, evidence of transit time effects, and the presence of unanticipated stratified layers are some of the phenomena that may be seen. The natural consequence of the observed sensitivity to the detailed transport physics is that great care must be taken when interpreting the data. However, the revealed detail ensures that essential effects are not overlooked. GRA

75 PLASMA PHYSICS

Includes magnetohydrodynamics and plasma fusion.
For ionospheric plasmas see *46 Geophysics*. For space plasmas see *90 Astrophysics*.

N91-21880*# Colorado State Univ., Fort Collins. Dept. of Mechanical Engineering.
PLASMA CONTACTOR RESEARCH, 1990 Annual Report, 1 Jan. 1989 - 1 Jan. 1990
John D. Williams and Paul J. Wilbur Jan. 1991 81 p
(Grant NAG3-776)
(NASA-CR-187097; NAS 1.26:187097) Avail: NTIS HC/MF A05 CSCL 20I

Emissive and Langmuir probes were used to measure plasma potential profiles, plasma densities, electron energy distributions, and plasma noise levels near a hollow cathode-based plasma contactor emitting electrons. The effects of electron emission current (100 to 1500 mA) and contactor flowrate (2 to 10 sccm (Xenon)) on these data are examined. Retarding potential analyzer (RPA) measurements showing that high energy ions generally stream from a contactor along with the electrons being emitted are also presented, and a mechanism by which this occurs is postulated. This mechanism, which involves a high rate of ionization induced between electrons and atoms flowing together from the hollow cathode orifice, results in a region of high positive space charge and high positive potential. Langmuir and RPA probe data suggests that both electrons and ions expand spherically from this potential hill region. In addition to experimental observations, a simple one-dimensional model which describes the electron emission process and predicts the phenomena just mentioned is presented and is shown to agree qualitatively with these observations. Experimental results of the first stage of bilateral cooperation with the Italian Institute of Interplanetary Space Physics (IFSI CNR) are presented. Sharp, well-defined double layers were observed downstream of a contactor collecting electrons from an ambient plasma created in the IFSI Facility. The voltage drop across these double layers was observed to increase with the current drawn from the ambient plasma. This observation, which was not as clear in previous IFSI tests conducted at higher neutral pressures, is in agreement with previous experimental observations made at both Colorado State University and NASA Lewis Research Center. Greater double layer voltage drops, multiple double layers, and higher noise levels in the region near the double layers were also observed when a magnetic field was imposed and oriented perpendicular to the line joining the contactor and simulator. Author

N91-21881# Massachusetts Inst. of Tech., Cambridge. Dept. of Aeronautics and Astronautics.
THE STUDY OF PLASMA CLOUDS AROUND LARGE ACTIVE SPACE STRUCTURES Final Report, May 1986 - Dec. 1989
Daniel Hastings 7 Nov. 1989 85 p
(Contract F19628-86-K-0018)
(AD-A230634; GL-TR-89-0306) Avail: NTIS HC/MF A05 CSCL 20/9

Large spacecraft such as the Space Shuttle perturb the natural environment by releasing contaminants into the atmosphere through outgassing, chemical dumps, and thruster firings. A fluid model was developed to describe the large scale structure of the contminant plasma cloud. The model is two dimensional with the structure along the magnetic field being averaged out. The model predicts that an important parameter is the parallel length scale

of the cloud since this determines the effective length over which electrons can be drawn to short out the ions flowing perpendicular to the magnetic field. In addition, a significant amount of work was done on the small scale kinetic processes that occur in the contaminant cloud and that cannot be explained by the fluid model. These small scale processes include instabilities in the cloud, ion acceleration by the cloud and anomalies ionization in the cloud.
GRA

N91-21882# Joint European Torus Project, Abingdon (England).
SAWTEETH AND THEIR STABILIZATION IN JET
D. J. Campbell 1990 12 p Presented at the 13th International Conference on Plasma Physics and Controlled Nuclear Fusion Research, Washington, DC, 1-6 Oct. 1990
(Contract DE-AC05-84OR-21400)
(DE91-005459; CONF-901025-36; IAEA-CN-53/A-6-3) Avail: NTIS HC/MF A03

Sawtooth relaxations control the central plasma parameters in most JET discharges and, as a result, have a significant influence on fusion performance. Several techniques have, therefore, been developed for the stabilization of sawteeth in various JET operating regimes. Under some circumstances, sawtooth suppression appears to be associated with the central safety factor, q(sub 0), rising above unity. However, in other cases, q(sub 0) remains significantly below unity and it is thought that stabilization is due to the influence of a population of energetic particles. Detailed measurements of the evolution of the current profile in JET during sawteeth have confirmed that q(sub 0) remains below unity throughout the sawtooth cycle and thus the trigger for the sawtooth collapse remains problematic. Further diagnostic investigations of the sawtooth collapse have shown that the collapse takes the form of a convective plasma flow, but the cause of the resultant energy transport is not understood. DOE

N91-21883# Joint European Torus Project, Abingdon (England).
HIGH PERFORMANCE H MODES IN JET
A. Tanga 1990 18 p Presented at the 13th International Conference on Plasma Physics and Controlled Nuclear Fusion Research, Washington, DC, 1-6 Oct. 1990
(Contract DE-AC05-84OR-21400)
(DE91-005488; CONF-901025-33; IAEA-CN-53/A-4-1) Avail: NTIS HC/MF A03

In JET the scientific properties and technical basis of good confinement regimes have been evaluated in the light of the potential extrapolation of such regimes to reactor requirements. In this paper the main experimental H-mode results are discussed highlighting global confinement scaling, low q regimes, the role of the target plate material, the density limit, and finally sawtooth suppression and hot-ion mode. DOE

N91-21884# Joint European Torus Project, Abingdon (England).
COMPARISON OF BERYLLIUM AND GRAPHITE FIRST-WALLS IN JET
P. R. Thomas 1990 10 p Presented at the 13th International Conference on Plasma Physics and Controlled Nuclear Fusion Research, Washington, DC, 1-6 Oct. 1990
(Contract DE-AC05-84OR-21400)
(DE91-005489; CONF-901025-32; IAEA-CN-53/A-5-3) Avail: NTIS HC/MF A02

A JET tokamak has operated with beryllium as a first-wall material in 1989 and 1990. An initial period with beryllium evaporation onto the original graphite surfaces was followed by operation with beryllium belt-limiter tiles. Beryllium Faraday shields for the ICRH antennae and lower X-point target tiles were installed for experiments in 1990. The use of beryllium has increased the density limit, significantly reduced deconditioning following disruptions, allowed heavy gas fueling for impurity control, reduced the impurity influx from the ICRH antennae so that ICRH-only H modes were possible for the first time and permitted hot-ion plasmas on the outer limiters. This paper describes the primary effects of beryllium which led to these improvements in performance. DOE

N91-21885# Joint European Torus Project, Abingdon (England).
HIGH DENSITY REGIMES AND BETA LIMITS IN JET
P. Smeulders 1990 10 p Presented at the 13th International Conference on Plasma Physics and Controlled Nuclear Fusion Research, Washington, 1-6 Oct. 1990
(Contract DE-AC05-84OR-21400)
(DE91-005490; CONF-901025-34; IAEA-CN-53/A-3-4) Avail: NTIS HC/MF A02

Results are first presented on the density limit in JET discharges with graphite (C), Be gettered graphite and Be limiters. There is a clear improvement in the case of Be limiters. The Be gettered phase showed no increase in the gas fueled density limit, except with Ion Cyclotron Resonance Heating (ICRH), but, the limit changed character. During MARFE-formation, any further increase in density was prevented, leading to a soft density limit. The soft density limit was a function of input power and impurity content with a week dependence on q. Helium and pellet fuelled discharges exceeded the gas-fuelled global density limits, but essentially had the same edge limit. In the second part, results are presented of high (beta) operation in low-B Double-Null (DN) X-point configurations with Be-gettered carbon target plates. The Troyon limit was reached during H-mode discharges and toroidal (beta) values of 5.5 percent were obtained. At high beta, the sawteeth were modified and characterised by very rapid heat-waves and fishbone-like pre- and post-cursors with strongly ballooning character. DOE

N91-21886# Joint European Torus Project, Abingdon (England).
ICRF HEATING IN REACTOR GRADE PLASMAS
J. Jacquinot, V. P. Bhatnagar, M. Bures, G. A. Cottrell, L. G. Eriksson, C. H. Sack, D. F. H. Start, A. Taroni, T. Hellsten (Royal Inst. of Tech., Stockholm, Sweden), and R. Koch 1990 12 p Presented at the 13th International Conference on Plasma Physics and Controlled Nuclear Fusion Research, Washington, 1-6 Oct. 1990
(Contract DE-AC05-84OR-21400)
(DE91-005491; CONF-901025-35; IAEA-CN-53/E-2-1-1) Avail: NTIS HC/MF A03

Impurity influxes in JET discharges due to ICRH have been reduced to insignificant levels. This has allowed high quality H-modes to be produced with ICRH alone and has enhanced the density limit which is now the same as the NBI limit. Improvement in the deuterium fuel fraction has led to the generation of 100kW of non thermal (sup 3)He-D fusion power. Alpha-particle simulations using MeV ions created by ICRH show classical energy loss and suggest that alpha-heating in a reactor will be highly efficient. A clear demonstration of TTMP damping of the fast wave in high beta plasmas has been achieved. A broadband ICRH system is proposed for NET/ITER which will allow fast wave current drive and central ion heating for burn control and ignition. DOE

N91-21887# General Atomic Co., San Diego, CA.
TRANSPORT IN AUXILIARY-HEATED, HOT-ION H-MODE AND L-MODE DISCHARGES IN THE DIII-D TOKAMAK
K. H. Burrell, R. J. Groebner, T. N. Carlstrom, R. R. Dominguez, P. Gohil, J. M. Lohr, T. W. Petrie, G. T. Sager, H. E. StJohn, and D. P. Schissel et al Nov. 1990 18 p Presented at the 13th International Conference on Plasma Physics and Controlled Nuclear Fusion Research, Washington, 1-6 Oct. 1990
(Contract DE-AC03-89ER-51114)
(DE91-008924; GA-A-20277; CONF-901025-42) Avail: NTIS HC/MF A03

We have studied local thermal and angular momentum transport in the bulk of neutral-beam-heated, hot-ion L-mode and H-mode plasmas in DIII-D. This work has been done at reactor-relevant central ion temperatures up to 14.5 keV and normalized beta values up to beta(sub N) = 3, which approach the beta limit seen in DIII-D. Significant improvement in local transport has been seen for the L to H transition. This demonstrates that the confinement improvement in H-mode is not simply due to the creation of a transport barrier at the plasma edge. The dominant improvement is in the electron thermal and angular momentum transport. Ion transport is at the neoclassical level in the center of the H-mode

discharges. The local transport in the outer half of the plasma improves markedly within 10 ms after the L to H transition. The electron density profile flattens in this region on the same time scale. This connection leads to the speculation that the confinement improvement is caused by this flattening. Comparison of experimental results with the predictions of electrostatic, drift-wave-induced transport show significant disagreement. Magnetic-fluctuation-based models agree better with experiment, but still exhibit significant discrepancies. Complete, quantitative agreement between theory and experiment will require further improvement in the theory. DOE

N91-21888# General Atomic Co., San Diego, CA.
ROLE OF THE EDGE ELECTRIC FIELD AND MICROTURBULENCE IN THE L-H TRANSITION
R. J. Groebner, K. H. Burrell, T. N. Carlstrom, P. Gohil, R. P Seraydarian, W. A. Peebles, E. J. Doyle, R. Philipona, and H. Matsumoto (Japan Atomic Energy Research Inst., Tokyo.) Nov. 1990 11 p Presented at the 13th International Conference on Plasma Physics and Controlled Nuclear Fusion Research, Washington, 1-6 Oct. 1990
(Contract DE-AC03-89ER-51114)
(DE91-008925; GA-A-20272; CONF-901025-41) Avail: NTIS HC/MF A03

Two clear signatures of the L-H transition in the DIII-D tokamak are that the edge poloidal rotation velocity, upsilon(sub theta), abruptly increases, implying that the radial electric field, E(sub tau), becomes more negative, and the level of density fluctuations is abruptly suppressed in a narrow region at the plasma edge. The absolute values of E(sub tau) and upsilon(sub theta) have maxima within 1-2 poloidal gyroradii rho(sub i theta) of the plasma edge, indicating that large negative and positive gradients of E(sub tau) and upsilon(sub theta) exist near the plasma edge in a region called the 'shear' layer. Density fluctuations are reduced and the gradients of T(sub i), T(sub e), n(sub e), and the carbon density increase in the shear layer at the time of transition. These data qualitatively support theoretical scenarios in which changes in E(sub tau) or of the gradients of E(sub tau) or upsilon(sub theta) cause a suppression of microturbulence, resulting in increases in the T(sub i) and density gradients. DOE

N91-21889# Colorado School of Mines, Golden.
COLORADO SCHOOL OF MINES FUSION GAMMA RAY DIAGNOSTIC PROJECT
F. E. Cecil 28 Feb. 1991 23 p
(Contracts DE-FG02-88ER-53276; DE-FG02-87ER-40342; DE-AC02-76CH-03073)
(DE91-009259; DOE/ER-53276/3) Avail: NTIS HC/MF A03

The purpose of our fusion gamma ray project continues to be the development of fusion gamma ray spectrometry as a diagnostic of high temperature fusion plasmas. The three broad areas in support of this purpose are: measurement of gamma ray producing reactions at low energies; development of gamma ray spectrometers capable of measuring the gamma ray yields from current and proposed fusion plasma devices; and determination of appropriate plasma parameters from measured fusion gamma ray yields at present fusion plasma devices. This report summarizes the progress made in these three areas. The recently completed measurement of the radiative capture of protons by the nuclei Li-6, Li-7, Be-9, and B-11 is summarized. Preliminary results of the investigation of the radiative capture of deuterons by Li-6 and B-10 as well as additional data taken on the reaction D(d,gamma)He-4 at very low energies are also presented. DOE

N91-21890# Institute of Nuclear Physics, Krakow (Poland).
CHARACTERISTIC X RAYS METHOD FOR DETECTING COLD FUSION
J. Dryzek, B. Sepiol, and A. Z. Hrynkiewicz 1989 11 p
(DE91-619982; INP-1458/PL) Avail: NTIS HC/MF A03

The characteristic x-ray method for detecting so-called 'cold fusion' was used. Two experiments were performed and no effect that could point to any nuclear reactions inside a palladium lattice packed with deuterium atoms was observed. The limit of the fusion rate which could be detected in the experiment was estimated as ca. 10(exp minus 21) fusion/sD sub 2. DOE

N91-21891# National Inst. for Fusion Science, Nagoya (Japan).
OBSERVATION OF PARALLEL VISCOSITY IN THE CHS HELIOTRON/TORSATRON
K. Ida, H. Yamada, H. Iguchi, and K. Itoh Jan. 1991 24 p
(NIFS-70; ISSN-0915-633X) Avail: NTIS HC/MF A03

Damping of the toroidal velocity owing to parallel viscosity is observed in the plasma with a tangential neutral beam injection in the CHS (Compact Helical System) Heliotron/Torsatron device. Toroidal velocity profile is dominated by the perpendicular viscosity when magnetic field modulation is weak near axis. However, the parallel viscosity is found to be dominant when the modulation is strong enough and to increase in proportion to the square of the modulation of magnetic field. The absolute values of the viscosity agree with the neoclassic prediction within a factor of three. Author

N91-21892# National Inst. for Fusion Science, Nagoya (Japan).
SPECTRAL ANALYSIS OF THE HELIOTRON FIELD WITH THE TOROIDAL HARMONIC FUNCTION IN A STUDY OF THE STRUCTURE OF BUILT-IN DIVERTOR
H. Kaneko Jan. 1991 37 p
(NIFS-71; ISSN-0915-633X) Avail: NTIS HC/MF A03

Representation of the vacuum magnetic field by a set of harmonic functions is useful for an analysis of a magnetic configuration. To analyze a helical configuration precisely, a harmonic function describing a pure helicity of the configuration is desired especially in heliotrons, where the good quasi-symmetry is regarded as an advantage for a helical built-in divertor. Owing to the specific mode numbers in both the toroidal and the poloidal directions, the toroidal harmonic function is appropriate for a study of the helical field when a practical method for a numerical calculation is provided. The helical components resonant with the helicity of the coil are dominant. A deviation from the natural winding law was found to be peculiar: only the components resonant with the helicity of the coil are dominant. A deviation from the natural winding law, such as in a traditional winding law, causes an enhancement of off-resonant components. The unique toroidal coordinates and, hence, the unique spectral representation is determined by a spectral series of the maximum area for the convergence of the field expression. The high accuracy of the representation was applied to a numerical investigation of the intricate structure of a helical divertor. A reticular structure of the scrap-off layer in a helical system is visualized with a trace of unclosed separatrix. The field line at the X-point is a nearly pure helix in the toroidal coordinates, and it was confirmed that the deviation is sufficiently small for divertor baffles to be rigidly installed, even when some additional field is expected in an experiment. Author

N91-21893# National Inst. for Fusion Science, Nagoya (Japan).
EFFECT OF ELECTRIC FIELD INHOMOGENEITIES ON DRIFT WAVE INSTABILITIES AND ANOMALOUS TRANSPORT
S.-I. Itoh, H. Sanuki, and K. Itoh Jan. 1991 23 p
(NIFS-72; ISSN-0915-633X) Avail: NTIS HC/MF A03

Effect of inhomogeneity of radial electric field on drift wave instabilities is investigated. Curvature of static potential gives rise to an additional Landau resonance. Critical conditions for the stability due to sheared ExB motion of ions are estimated. Effect of anomalous transport coefficient is also discussed. Author

N91-21894# National Inst. for Fusion Science, Nagoya (Japan).
STABILITIES OF REGULAR MOTION IN THE RELATIVISTIC STANDARD MAP
Y. Nomura, Yoshi H. Ichikawa, and W. Horton (Texas Univ., Austin.) Feb. 1991 33 p
(NIFS-73; ISSN-0915-633X) Avail: NTIS HC/MF A03

Analysis of the relativistic standard map is one of the important problems to understand nonlinear interaction between waves and charged particles in the relativistic dynamics. In the relativistic

standard map, in general, chaotic motion is strongly suppressed and regular motion such as periodic orbit plays dominant roles in the phase space. Location of periodic points is predicted using symmetric lines of the map. Local stability of periodic points is investigated by introducing the residue of the orbit which characterizes the eigenvalue of the area-preserving map. It is found that the exchange of stable and unstable points takes place at some value of the relativistic parameter. Special behavior of the residue of the Poincare-Birkhoff period-4 points are also examined and related bifurcations are clarified. Author

N91-21895# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
DESIGN AND CONSTRUCTION OF A FORMED PULSE CIRCUIT FOR A PLASMA CENTRIFUGE [PROJETO E CONSTRUCAO DE UM CIRCUITO FORMADOR DE PULSO PARA A CENTRIFUGA DE PLASMA]
Renato Sergio Dallaqua, Edson DelBosco, Gerson Otto Ludwig, and Antonio Montes Oct. 1990 37 p In PORTUGUESE; ENGLISH summary
(INPE-5161-RPE/639) Avail: NTIS HC/MF A03

The project construction and the performance of a pulse LC (logic circuit) network for the Plasma Centrifuge experiment is presented. Using numerical calculation, to solve Kirchoff's equations of the circuit, the values of the inductors necessary to obtain a pulse of plasma current practically constant with the duration of about 12 microsec were determined. Author

N91-21896# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
EXPERIMENTAL STUDY PROJECT OF PLASMA WAVES AND TURBULENCES [PROJETO DE ESTUDO EXPERIMENTAL DE ONDAS E TURBULENCIAS EM PLASMAS]
Jose Leonardo Ferreira Sep. 1990 39 p In PORTUGUESE; ENGLISH summary Submitted for publication
(INPE-5127-RPE/632) Avail: NTIS HC/MF A03

The objective was to perform experiments with wave phenomena on plasmas. Particular attention is given to Langmuir and whistler waves due to its relationship with several phenomena occurring on space and lab plasmas. The new concepts of particle acceleration with electromagnetic waves, the auroral phenomena on the polar regions and the charged particle precipitation to the atmosphere through anomalies of the earth magnetic field are examples where these waves have an important role. The propagation is studied of these waves in a quiessent plasma machine. This machine is able to produce a plasma with density and temperature with values similar to which is met in the ionosphere. Author

N91-21897# Joint European Torus Project, Abingdon (England).
RECENT JET RESULTS AND FUTURE PROSPECTS
P. H. Rebut 1990 22 p Presented at the 13th International Conference on Plasma Physics and Controlled Nuclear Fusion Research, Washington, 1-6 Oct. 1990
(Contract DE-AC05-84OR-21400)
(DE91-005474; CONF-901025-37; IAEA-CN-53/A-1-2) Avail: NTIS HC/MF A03

The latest results of JET plasmas in transient and steady states are presented. Substantial improvements in plasma purity and corresponding reductions in plasma dilution have resulted from the use of beryllium as the first wall material facing the hot plasma. As a consequence, plasmas with a fusion triple product (n(sub D)(0)(tau)(sub E)T(sub i)(0)) in the range 8-9 x 10(exp 20)/cu m skeV have been achieved (within a factor of 8 that required in a fusion reactor), albeit under transient conditions. The general JET performance has also improved, allowing the parameters of a reactor plasma to be individually achieved in JET. In view of their importance for reactors, the JET results are presented with particular emphasis on their significance for the formulation of a plasma model for the Next Step. However, impurity influxes limit the attainment of better parameters and prevent the realization of steady state conditions at high heating powers. To address these problems of impurity control, plasma fueling and helium ash exhaust, a New Phase is planned for JET. An axisymmetric pumped divertor configuration will allow operating conditions close to those of a reactor. The divertor configuration should demonstrate a concept of impurity control and determine the size and geometry needed to fulfill this concept in a reactor. It should identify appropriate materials for plasma facing components and define the operational domain for the Next Step. DOE

N91-21898# Lawrence Livermore National Lab., CA.
SOME OBSERVATIONS CONCERNING ALPHA INSTABILITIES AND DRIVEN TOKAMAK REACTORS
T. K. Fowler (California Univ., Berkeley.) 16 Jul. 1990 9 p
(Contract W-7405-eng-48)
(DE91-008628; UCRL-ID-104566) Avail: NTIS HC/MF A02

While much research is needed to assess the reality and consequences of alpha-induced instabilities, crude transport estimates for the TAE (toroidicity induced Alfven eigenmode) mode indicate that as little as 10 percent of the alpha energy would be deposited in steady-state. Even so, CIT and the ITER technology phase would meet their minimal goals of $Q = 5$ if only the alphas themselves are ejected and not the fuel itself. Higher gain up to Q approximately 20 may be possible in driven reactors of a different design, depending on the effects of aspect ratio and other geometric features on confinement. Very high gain still requires alpha testing. DOE

N91-21899# Thermo Electron Technologies Corp., San Diego, CA.
LASER DIAGNOSTICS FOR PLASMA TURBULENCE
1991 24 p
(Contract DE-FG03-90ER-54088)
(DE91-009377; DOE/ER-54088/1) Avail: NTIS HC/MF A03

The purpose of this effort is to further develop the multiple-beam laser scattering diagnostic for tokamak plasmas. Present laser scattering diagnostics have very poor spatial resolution. Yet good spatial resolution is necessary if adequate comparison of theory and experiment is to occur. The proposed multiple beam scattering diagnostic promises a spatial resolution of approximately 10 cm at a fluctuation wave number of 5 cm(exp -1) when the angular envelope of the beams is 0.1 radians. A larger angular envelope would further improve the spatial resolution. This kind of spatial resolution is impossible with current laser scattering diagnostics. Enclosed are two items. These items constitute the major results of this study. Appendix A is a draft of a paper being prepared for submission to the journal on the review of scientific instruments. This paper consists of three sections. Section 1 compares the proposed diagnostic to conventional laser scattering diagnostics and argues for the need of increased spatial resolution. Section 2 presents a thorough rendering of the conceptual basis of the proposed multiple beam diagnostic. Section 3 presents an optical design suitable for use on the TEXT upgrade tokamak. Appendix B is a schematic of a proposed proof-of-principle bench-top experiment of the multiple beam scattering diagnostic. It is designed to demonstrate the concept thoroughly at a greatly reduced cost. An actual multiple beam CO2 laser scattering experiment on a controlled laboratory plasma would be a good follow-up before attempting construction of the diagnostic on a major tokamak. DOE

N91-21900# Maryland Univ., College Park. Lab. for Plasma Research.
TIME-RESOLVED EXTREME-ULTRAVIOLET SPECTROSCOPY OF LASER-PRODUCED PLASMAS ORIGINATING AT THE PARYLENE LAYER OF MICROBALLON TARGETS
H. R. Griem and J. Moreno Mar. 1991 6 p
(Contract DE-FG03-90SF-18438)
(DE91-009378; DOE/SF-18438/1) Avail: NTIS HC/MF A02

In experiments this past year at the University of Rochester's Laboratory for Laser Energetics we obtained time-integrated and time-resolved spectra from the ultraviolet to the x-ray region. We have investigated various phenomena in laser-produced plasmas including spectral line broadening, plasma expansion velocities, ionization, and recombination of low-Z materials in spherical targets,

and the formation of satellites near some resonance lines. In addition we have improved our spectroscopic instrumentation.
DOE

N91-21901# Pennsylvania State Univ., University Park. Dept. of Nuclear Engineering.
KINETIC STABILITY OF FIELD-REVERSED CONFIGURATIONS
J. L. Staudenmeier and M.-Y. Hsiao Jan. 1991 133 p
(Contract DE-FG02-90ER-53302)
(DE91-009530; DOE/ER-53302/3) Avail: NTIS HC/MF A07

The internal tilt mode is considered to be the biggest threat to Field-Reversed Configuration (FRC) global stability. The tilt stability of the FRC is studied using the MHD, Hall MHD, and the Vlasov-fluid (Vlasov ions, cold massless fluid electrons) models. Nonlinear Hall MHD calculations showed that the FRC was stable to the tilt mode when the s value of the FRC was below a critical value that was dependent on plasma length. The critical s value is larger for longer plasma equilibria. The stability of FRC's with toroidal field was studied with a linear initial value MHD code. The calculations showed an axial perturbation wavelength of the most unstable eigenfunction that was consistent with internal probe measurements made on translated FRC's. Linear Vlasov-fluid eigenvalue calculations showed that kinetic ion effects can change both the growth rate and the structure of the eigenfunctions when compared to the corresponding MHD modes. Calculations on short FRC equilibria indicate that MHD is not the appropriate small gyroradius limit of the Vlasov-fluid model because the axial transit time of a thermal ion is approximately equal to an MHD growth time for the tilt mode. Calculations were done using a small number of unstable MHD eigenfunctions as basis functions in order to reduce the dimensionality of the stability problem. The results indicated that this basis set can produce inaccurate growth rates at large value for s for some equilibria. DOE

N91-21902# Lawrence Livermore National Lab., CA.
CHARACTERIZATION OF THE PLASMA-SWITCH INTERACTION IN THE LBL HIF ION SOURCE
D. W. Hewett and H. L. Rutkowski (California Univ., Berkeley. Lawrence Berkeley Lab.) 10 Dec. 1990 10 p Presented at the International Symposium on Heavy Ion Inertial Fusion, Monterey, 3-6 Dec. 1990
(Contract W-7405-eng-48)
(DE91-009479; UCRL-JC-104984-R1; CONF-901219-10) Avail: NTIS HC/MF A02

A new way to characterize the performance of the LBL HIF ion source was found. In the LBL source, ions are drawn from an arc generated plasma reservoir in which the electrons are confined by a negative-biased switch mesh. Stagnation of the plasma is prevented by absorption of the excess ion flow on this mesh. The ion beam is generated by an external negative voltage that provides Child-Langmuir extraction of the ions through the switch mesh. The physics requirements of the source are explained and switch mesh parameters needed for successful operation are deduced.
DOE

N91-21903# Lawrence Livermore National Lab., CA.
THE STREAMLINED DARWIN FIELD METHOD (AND A SOLUTION TECHNIQUE THAT MAKES IT PRACTICAL)
D. W. Hewett, D. J. Larson, and S. Doss 26 Oct. 1990 6 p Presented at the 32nd Annual Meeting of the American Physical Society - Division of Plasma Physics (APS/DPP); US-Japan Workshop on Advances in Simulation Techniques Applied To Plasmas and Fusion, Cincinnati, 12-16 Nov. 1990; 26-28 Sep. 1990
(Contract W-7405-eng-48)
(DE91-009482; UCRL-JC-105124; CONF-9011127-17; CONF-9009269-8) Avail: NTIS HC/MF A02

The new Streamlined Darwin Field (SDF) model eliminates some Boundary Conditions (BCs) in which plasma-wall boundaries play a significant role in plasma behavior. The new formulation trades difficult BC issues for strongly coupled 2nd order partial differential equations. A particular version of ADI called Dynamic ADI (DADI) is applied to this set of equations that is sufficiently fast to make solution of the SDF model practical in an initial-value PIC code.
DOE

76 SOLID-STATE PHYSICS

Includes superconductivity.
For related information, see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers.*

N91-21904# Aerospace Corp., El Segundo, CA. Lab. Operations.
SUBTHRESHOLD I-V CHARACTERISTICS OF AlGaAs/GaAs MODFETs: THE ROLE OF UNINTENTIONAL ACCEPTORS
Richard J. Krantz and Walter L. Bloss 19 Oct. 1990 21 p
(Contract F04701-88-C-0089)
(AD-A230110; TR-0090(5925-01)-2; SSD-TR-90-46) Avail: NTIS HC/MF A03 CSCL 20/12

A strong inversion, depletion layer model of threshold has been extended to describe subthreshold I-V characteristics in MODFETs (modulation doped field-effect transistors). The results of this calculation yield the MODFET equivalent of the MOSFET (metal-oxide semiconductor field-effect transistor) charge sheet subthreshold model. For typical molecular beam epitaxy (MBE) grown structure, the subthreshold current may differ by two-orders of magnitude for a given gate voltage V sub g and drain-to-source voltage V sub ds as the acceptor doping varies from 1 to 100 x 10 to the 13th power. For these acceptor doping densities, the gate voltage, for a given drain-to-source voltage, needed to maintain a constant subthreshold current, varies by only about 0.1 V. If the acceptor density is increased to 10 to the 17th power/cc, a large increase (approx. 0.8 V) in the gate voltage is required to maintain a constant subthreshold current. These changes in subthreshold current with acceptor concentration in the bulk GaAs are significant and need to be included in an accurate MODFET model. GRA

N91-21905# Massachusetts Inst. of Tech., Cambridge.
GRAIN BOUNDARIES Progress Report, 15 Feb. - 15 Oct. 1990
R. W. Balluffi and P. D. Bristowe 1990 18 p
(Contract DE-FG02-87ER-45310)
(DE91-007932; DOE/ER-45310/30) Avail: NTIS HC/MF A03

Grain boundaries were investigated. The research was focused on the following four major efforts: study of the aromatic structure of grain boundaries by means of x ray diffraction, transmission electro microscopy and computer modeling; study of grain boundary migration; study of short circuit diffusion along grain boundaries; and the development of Thin Film Deposition/Bonding Apparatus for the manufacture of high purity bicrystals. DOE

N91-21906# California Univ., Berkeley. Lawrence Berkeley Lab.
PRESSURE DEPENDENCE OF DEEP CENTERS BY CAPACITANCE SPECTROSCOPIES INSIDE THE DIAMOND ANVIL CELL
P. Y. Yu and M. F. Li (California Univ., Berkeley.) Aug. 1990 10 p Presented at the 4th International Conference on High Pressure in Semiconductor Physics, Porto Carra (Greece), 11-13 Aug. 1990
(Contract DE-AC03-76SF-00098)
(DE91-008927; LBL-29888; CONF-9008196-1) Avail: NTIS HC/MF A02

The use of diamond anvil high-pressure cells to study deep centers in semiconductors by means of capacitance transient spectroscopies is described. The technique is illustrated by recent results on DX centers induced by pressure in GaAs, the P(sub b) center at the SiO2/Si interface and the Schottky barrier formed by Pt on GaAs. DOE

N91-21907# California Univ., Berkeley. Lawrence Berkeley Lab.
STRUCTURAL CHARACTERIZATION OF THE Ag/YBa2Cu3O(7-x) INTERFACE Ph.D. Thesis

M. E. Tidjani May 1990 115 p
(Contract DE-AC03-76SF-00098)
(DE91-009112; LBL-29843) Avail: NTIS HC/MF A06

Most applications of superconductors (i.e., power transmission cables and tapes, electronic circuits, supermagnets) require some interface with a power source or an electronic device that enables electrons to be injected into, and removed from the superconductor. The quality of metal-ceramic contacts in strongly dependent upon the structural properties of the metal-ceramic interface which depends on the processing conditions and the interaction between the two materials in contact. The present research is intended to characterize the interface microstructure and long term stability of the deposited silver metal in contact to the superconducting oxide YBa2Cu3O(7-x) (YBCO). DOE

N91-21908# Academy of Sciences (USSR), Leningrad. Inst. Yadernoj Fiziki.
DOUBLE 4f-COLLAPSE IN Ce(0.9-x)Yb(x)Th(0.1)
Yu. P. Smirnov, A. E. Sovestnov, G. I. Terekhov, A. V. Tyunis, and V. A. Shaburov 1989 9 p In RUSSIAN; ENGLISH summary
(DE91-619752; LIYF-1518) Avail: NTIS HC/MF A02

The simultaneous sharp change and reversible change with temperature of the x ray line energy of Ce and Yb in Ce(0.9-x)Yb(x)Th(0.1) are experimentally revealed. It is shown that this effect is connected with a delocalization of the 4f-electron Ce and Yb (i.e., with electronic transitions Ce(3+), 4f(sup 1)-Ce(4+), 4f(sup 0), Yb(2+), 4f(sup 14)-Yb(3+), and 4f(sup 13)). DOE

N91-21909# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Inst. Atomnoj Ehnergii.
STUDY OF RELATIVISTIC ELECTRONS AT CHANNELING IN A BERYLLIUM THICK CRYSTALS
T. A. Bobrova and L. I. Ognev 1989 8 p In RUSSIAN; ENGLISH summary
(DE91-619859; IAE-4810-11) Avail: NTIS HC/MF A02

The possibility of utilization of beryllium crystals at plane channeling of electrons with energies of 4 to 30 MeV is considered. The radiation yield at the channeling with regard to its absorption by crystals of various thickness is estimated, and a comparison with diamond and silicon crystals is performed. DOE

N91-21910*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
THE SERIES Bi2Sr2Ca(n-1) Cu(n)O(2n+4) (1 LESS THAN OR EQUAL TO n LESS THAN OR EQUAL TO 5): PHASE STABILITY AND SUPERCONDUCTING PROPERTIES
Mark R. DeGuire, Narottam P. Bansal, David E. Farrell, Valerie Finan, Cheol J. Kim, Bethanie J. Hills, and Christopher J. Allen (Case Western Reserve Univ., Cleveland, OH.) 1989 20 p Presented at the 91st Annual Meeting of the American Ceramic Society, Indianapolis, IN, 23-27 Apr. 1989
(NASA-TM-103749; E-6000; NAS 1.15:103749) Avail: NTIS HC/MF A03 CSCL 20L

Phase relations at 850 and 870 C, melting transitions in air, oxygen, and helium were studied for Bi(2.1)Sr(1.9) CuO6 and for the Bi2Sr2Ca(n-1) Cu(n)O(2n+4) for n = 1, 2, 3, 4, 5, and infinity (CaCuO2). Up to 870 C, the n = 2 composition resides in the compatibility tetrahedron bounded by Bi(2+x)(Sr,Ca)(3-y) Cu2O8, (Sr,Ca)14 Cu24O41, Ca2CuO3, and a Bi-Sr-Ca-O phase. The n is greater than or equal to 3 compositions reside in the compatibility tetrahedron Bi(2+x)(Sr,Ca)(3-y) Cu2O8 - (Sr,Ca)14 Cu24O41 - Ca2CuO3 - CuO up to 850 C. However, Bi(2+x)Sr(4-y) Cu3O10 forms for n is greater than or equal to 3 after extended heating at 870 C. Bi(2+x)Sr(2-y) CuO6 and Bi(2+x)(Sr,Ca)(3-y) Cu2O8 melt in air at 914 C and 895 C respectively. During melting, all of the compositions studied lose 1 to 2 percent by weight of oxygen from the reduction of copper. Bi(2+x)Sr(2-y) CuO6, Bi(2+n)(Sr,Ca)-(3-y) Cu2O8, and Bi(2+x)(Sr,Ca)(4-y) Cu3O10 exhibit crystallographic alignment in a magnetic field, with the c-axes orienting parallel to the field. Author

N91-21911* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
ENHANCED SINGLE LAYER MULTI-COLOR OR LUMINESCENT DISPLAY WITH COACTIVATORS Patent
James B. Robertson, inventor (to NASA) 22 Jan. 1991 9 p Filed 13 Apr. 1989 Continuation-in-part of US-Patent-Appl-SN-140185, filed 31 Dec. 1987
(NASA-Case-LAR-14181-1; US-Patent-4,987,339; US-Patent-Appl-SN-338379; US-Patent-Appl-SN-140185; US-Patent-Class-313-502; US-Patent-Class-313-503; US-Patent-Class-313-506; US-Patent-Class-428-690; Int-Patent-Class-H05B-33/14) Avail: US Patent and Trademark Office CSCL 20L

The invention is an enhanced single layer, multi-color luminescent display comprising an insulator substrate and a single layer of host material having a smooth, flat top surface deposited thereon that hosts one or more different activators, therein forming a pattern of selected and distinctly colored phosphor areas which may be green, red, and blue respectively in the single layer of host material. Transparent electrical conductor means may be provided for subjecting selected areas of the pattern of colored phosphor areas to an electric field thereby forming a multi-color, single layer electroluminescent display. A coactivator such as a phosphor may be selectively introduced into one or more of the phosphor areas and to enhance the brilliance of the color or colors of the one or more selected phosphor areas without changing the electric field. A method of forming a multi-color luminescent display includes the steps of depositing on an insulator substrate, a single layer of host material with the properties to host varying quantities of different activators and a common activator into selected areas of said single layer of host material as by thermal diffusion or ion implantation to form a pattern of phosphor areas and of selectively enhanced colors in said single layer of host material.
Official Gazette of the U.S. Patent and Trademark Office

N91-21912# Sandia National Labs., Albuquerque, NM.
EBIC (ELECTRON BEAM INDUCED CURRENT) CONTRAST OF CLEAN, DECORATED AND DEUTERIUM PASSIVATED Si(Ge) EPITAXIAL MISFIT DISLOCATIONS
T. Q. Zhou, A. Buczkowski, Z. J. Radzimski, G. A. Rozgonyi (North Carolina State Univ., Raleigh.), C. H. Seager, and J. Panitz 1991 4 p Presented at the 179th Meeting of the Electrochemical Society, Washington, 5-10 May 1991
(Contract DE-AC04-76DP-00789)
(DE91-006967; SAND-91-0011C; CONF-910552-8) Avail: NTIS HC/MF A01

The electrical activity of as-grown and intentionally decorated misfit dislocations in an epitaxial Si/Si(Ge) heterostructure was examined using the electron beam induced current (EBIC) technique in a scanning electron microscope. Misfit dislocations, which were not visible initially, were subsequently activated either by an unknown processing contaminant or a backside metallic impurity. Passivation of these contaminated dislocations was then studied using low energy deuterium ion implantation in a Kaufman ion source. EBIC results show that the recombination activity of the decorated misfit dislocations was dramatically reduced by the deuterium treatment. Although a front side passivation treatment was more effective than a backside treatment, a surface ion bombardment damage problem is still evident. DOE

N91-21913# California Univ., Berkeley. Lawrence Berkeley Lab.
NONLINEAR OPTICAL SPECTROSCOPY OF Ce3(+) IONS IN INSULATING CRYSTALS Ph.D. Thesis
D. Piehler Nov. 1990 161 p
(Contract DE-AC03-76SF-00098)
(DE91-008928; LBL-29883) Avail: NTIS HC/MF A08

The experiments described are: electronic coherent anti-stokes Raman spectroscopy. CARS is a form of four waving mixing in which two input lasers at frequencies omega sub 1 and omega sub 2 interact within a nonlinear medium to produce a third coherent beam at frequency omega sub 3 = 2 omega sub 1 - omega sub

2. Resonances are observed in the signal at omega sub 3 as (omega sub 1 - omega sub 2) is swept through the electronic energy levels of the Ce(3+) ion. 4f (yields) 5d two-photon absorption. The simplest and most direct way to investigate the nature of the 5d configuration in Ce(3+):LuPO4 is by two-photon absorption. Although two-photon transients between the 4f and 5d configurations are formally parity forbidden they are allowed in second order by the odd parity components of the crystal field. One of the original motivations was to determine if electronic Raman processes in rare earth crystals could be strong enough for the observation of stimulated electronic Raman scattering. Stimulated electronic Raman scattering has been observed in atomic vapors, but not ever involving ions in crystals. No stimulated electronic Raman processes were observed in CeF3. DOE

N91-21914# Sandia National Labs., Albuquerque, NM.
ON THE CRYSTAL STRUCTURE OF BORON CARBIDES
B. Morosin, T. L. Aselage, and D. Emin 1990 4 p Presented at the 10th International Symposium on Borons, Borides and Related Compounds, Albuquerque, 27-30 Aug. 1990
(Contract DE-AC04-76DP-00789)
(DE91-009256; SAND-89-2869C; CONF-900870-10) Avail: NTIS HC/MF A01

Several crystals of boron carbide, grown from molten Cu, Pt, and Pd solutions using natural occurring as well as isotopically enriched boron, give essentially identical values for the lattice parameters. These parameters are consistent with carbon-saturated compositions near B4C. Detailed crystal structure refinement on some of these crystals yields positional and thermal parameters in good agreement with each other. More important, the thermal parameters of these studies are compared with those of crystals with lower carbon content (B13C2) as well as carbothermally prepared crystals. The thermal parameters of chain atoms for crystals with lower carbon content are both exceptionally large and much larger than those of crystals with composition near B4C. This result suggests that the crystals of lower carbon content contain a solid solution of C-B-C and C-B-B chains. DOE

N91-21915# Lawrence Livermore National Lab., CA.
INTERPLAY BETWEEN LOCAL ENVIRONMENT EFFECT AND ELECTRONIC STRUCTURE PROPERTIES IN CLOSE PACKED STRUCTURES
P. E. A. Turchi 16 Jan. 1991 8 p Presented at the Fall Meeting of the Materials Research Society, Boston, 24 Nov. - 1 Dec. 1990
(Contract W-7405-eng-48)
(DE91-008506; UCRL-JC-104591; CONF-901105-98) Avail: NTIS HC/MF A02

Within a tight binding framework, the interplay between local atomic arrangement, orbital directionality and phase stability properties is discussed for a series of tetrahedrally chose packed (tcp) structures. The common features which characterize the local densities of states of top phases can be explained by a moment analysis up to fourth order terms. On the contrary it is shown that structural energy differences between simple and top crystalline structures requires the knowledge of at least the fifth order moments, a fact which has been underestimated in the past. Finally, the relative stability of various representative geometries, including the ones of simple crystalline structures is examined as a function of the number of valence electrons. DOE

N91-21916# Brookhaven National Lab., Upton, NY.
MAGNETIC FIELD INDUCED BROADENING OF THE RESISTIVE TRANSITION IN EPITAXIAL FILMS OF YBa2Cu3O7 AND Y2Ba4Cu8O16
R. C. Budhani, M. Suenaga, and D. O. Welch 1990 10 p Presented at the Science and Technology of Thin-Film Superconductors Conference, Denver, 30 Apr. - 4 May 1990
(Contract DE-AC02-76CH-00016)
(DE91-009825; BNL-43779; CONF-900432-2) Avail: NTIS HC/MF A02

In this paper we report measurements of the resistive transition in YBa2Cu3O7 and Y2Ba4Cu8O16 films as a function of transport current density coplanar with applied magnetic field and the CuO2 planes. For both transverse and longitudinal current-field configurations, we observe a significant broadening of the transition. For low excitation currents, the strength of the dissipation is identical for longitudinal and transverse fields. At high transport currents, where the Current-Voltage (I-V) curves are non-linear, the transverse field however, results in a Lorentz force instability in the flux line lattice and a higher dissipation. Various physical processes which might lead to unusually large broadening of the transition observed in all classes of cuprate superconductors are discussed. DOE

N91-21917# California Inst. of Tech., Pasadena. Dept. of Applied Physics.
DEPENDENCE OF THE PHOTOREFRACTIVE PROPERTIES OF KTa(1-x)Nb(x)O3:Cu,V ON Cu VALENCE STATE CONCENTRATION Report, 1 Jan. - 30 Jun. 1990
Victor Leyva, Aharon Agranat, and Amnon Yariv 1 Jun. 1990 5 p
(Contract DAAG29-85-K-0261)
(AD-A230954; Rept-504) Avail: NTIS HC/MF A01 CSCL 20/2

Absorption measurements and electron microprobe analysis are used to determine the density of Cu1+ and Cu2+ ions in a photorefractive KTa1-xNbx03:Cu, V sample. Photorefractive measurements are made over a wide range of Cu1+ and Cu2+ concentrations, altered by a series of oxidation and reduction treatments. Diffraction efficiencies were varied by over an order of magnitude while erasure rates were varied by over two orders of magnitude. GRA

N91-21918# Brown Univ., Providence, RI. Dept. of Chemistry.
NUCLEATION AND GROWTH OF DIAMOND ON Si, Cu AND Au SUBSTRATES
C. M. Niu, G. Tsagaropoulos, J. Baglio, K. Dwight, and A. Wold 21 Dec. 1990 21 p
(Contract N00014-89-J-1849)
(AD-A231044; TR-10) Avail: NTIS HC/MF A03 CSCL 07/1

A hot tungsten filament reactor was used to deposit diamond films on silicon, copper and gold substrates. Diamond can be readily nucleated on all three substrates, but the nucleation density is greatly enhanced by prescratching with 0.25 micron diamond paste. Visual examination of photomicrographs of diamond crystallites formed on prescratched silicon substrates indicates that no new nuclei are formed between one and two hrs of deposition. However, new nuclei are formed throughout this period when the substrate is copper or gold. Deposited diamond films adhered to silicon substrates, but could be readily removed from copper and gold substrates. GRA

N91-21919# Brown Univ., Providence, RI. Dept. of Chemistry.
GROWTH AND CHARACTERIZATION OF THIN FILMS OF Y2O3, La2O3 AND La2CuO4
Y. M. Gao, P. Wu, K. Dwight, and W. Wold 21 Dec. 1990 21 p
(Contract N00014-89-J-1849)
(AD-A231046; TR-13) Avail: NTIS HC/MF A03 CSCL 09/1

Films were prepared by an ultrasonic nebulization and pyrolysis method using acetylacetonates of the corresponding metals in alcohol solvents as source materials. Homogenous, uniform films with good adherence have been obtained using this simple technique. As-deposited yttrium and lanthanum oxide films were poorly crystallized. After post-annealing in oxygen at higher temperature, they crystallized into cubic and hexagonal phases, respectively. Transparent yttrium and lanthanum oxide films have high electric breakdown voltages. Single phase polycrystalline La2CuO4 thin films were obtained from a source solution with a La:Cu ration of 2:1. GRA

N91-21920# Brown Univ., Providence, RI. Dept. of Chemistry.
PREPARATION AND CHARACTERIZATION OF IRON(III) OXIDE FILMS BY AN NOVEL SPRAY PYROLYSIS METHOD
C. M. Niu, C. Hannigan, Y.-T. Qian, S. Yang, and K. Dwight 21

Dec. 1990 17 p
(Contract N00014-89-J-1849)
(AD-A231047; TR-12) Avail: NTIS HC/MF A03 CSCL 07/1

Alpha-Fe2O3 thin films were deposited on silicon substrates by nebulization of a 0.01 M solution of iron acetylacetonate in a 50 percent methanol/water mixture followed by pyrolysis and annealing in flowing oxygen. The resulting films were characterized by x-ray diffraction, scanning electron microscopy, and their electrical transport behavior. The IR transmission spectrum of alpha-Fe2O3 recorded from such films agreed with published theoretical analysis based on the crystal structure. GRA

N91-21921# California Univ., Santa Barbara. Dept. of Electrical and Computer Engineering.
MOLECULAR BEAM EPITAXIAL GROWTH AND ELECTRONIC PROPERTIES OF GaP-ON-Si (211) HETEROSTRUCTURES, AND OF RELATED SYSTEMS Final Report, 15 Apr. 1985 - 30 Jun. 1990
Herbert Kroemer Nov. 1990 11 p
(Contract DAAG29-85-K-0107)
(AD-A231125; ARO-22280.11-EL) Avail: NTIS HC/MF A03 CSCL 20/12

Two fundamental problems involved in the hetero-epitaxial growth of GaAs on substrates were investigated: (1) The mechanism by which antiphase domain disorder is self-eliminating under proper growth conditions; (2) The minimization of misfit-induced threading dislocations, and the properties of those dislocations that remain, especially their interactions with superlattice buffer layers. Although the self-elimination of antiphase domain disorder under proper growth conditions is experimentally beyond the shadow of a doubt, no truly satisfactory explanation for this phenomenon has been found. We propose that the self-elimination is of kinetic rather than energetic origin, and that the details of the annihilation mechanism depend sensitively on details in the kinetics. Superlattice buffer layers are only marginally effective in reducing threading dislocation densities of the magnitude occuring in GaAs-on-Si growth, and they are unable to reduce the densities to anywhere near the levels desirable for the more demanding device applications, such as lasers. A truly satisfactory level of dislocation reduction will probably require island-like growth on patterned substrates. Threading dislocations interact strongly with superlattice. The effect was traced to a reduction in the mobility of the minority carrier along the superlattice wells, presumably caused by dislocation-induced well width fluctuations. this causes the minority carriers to be effectively trapped in regions of enhanced GRA

N91-21922# University of Southern California, Los Angeles. Center for Laser Studies.
OPTICAL NIPI DEVICE CHARACTERIZATION Final Report, Sep. 1989 - Apr. 1990
Alan Kost and Elsa Garmire Dec. 1990 28 p
(Contract F30602-88-D-0028)
(AD-A231157; RADC-TR-90-313) Avail: NTIS HC/MF A03 CSCL 12/5

The motivation of this research project was to develop ultra-sensitive nonlinear optical materials for optical sensor protection, optical signal processing, and optical switching. Experiments were performed which measured the response times of quantum well hetero n-i-p-i materials which exhibit nonlinearities at intensities of less that a Watt/sq cm. The effects of lateral carrier diffusion in these structures were also studied. It was discovered that carriers remain trapped in the quantum wells reducing the magnitude of the transmission change which can be optically induced. Recommendations are made, based on these results, for optimizing device performance. In particular, structures should have very short intrinsic regions and narrow or shallow barriers between the quantum wells. GRA

N91-21923# North Carolina Univ., Chapel Hill. Dept. of Chemistry.
AN INVESTIGATION OF Si-SiO2 INTERFACE CHARGES IN THERMALLY OXIDATED (100), (110), (111), (511) SILICON Interim Report
Susan C. Vitkavage, Eugene A. Irene, and Hisham Z. Massoud 6 Dec. 1990 33 p
(Contract N00014-89-J-1178)
(AD-A231244; TR-34) Avail: NTIS HC/MF A03 CSCL 07/4

Trends in the electronic properties of the Si-SiO2 interface with various processing have been frequently reported. The present study focuses on silicon substrate orientation dependent trends in fixed oxide charge, Q(sub f), and interface trap charge, D(sub it), for four silicon orientations: (100), (110), (111), and (511), for oxidation temperatures in the 750 to 1100 C range, with and without hydrogen-containing post-metal anneals, and for processing within and without a cleanroom. It is found that the presence of mobile ionic charge in non-cleanroom processing and the lack of post-metal annealing can either obscure or enhance some trends. Both Q(sub f) and D(sub it) increase for decreasing oxidation temperature for all silicon orientations. The orientational ordering of the charges varies with oxidation temperature and is dominated by the silicon atom areal density at the lowest temperatures with (110) Si having the highest charge, but a change to the (111) orientation is observed at higher oxidation temperatures. This orientational charge parallels the orientational oxidation rate ordering but not the intrinsic stress. A model is proposed that considers the orientationally dominated oxidation rate, viscous relaxation, and strain accommodation across the interface as crucial processes. GRA

N91-21924# Pennsylvania Univ., Philadelphia.
MAGNETIC QUASICRYSTALS Final Report, 1 Oct. 1987 - 30 Sep. 1990
Takeshi Egami Nov. 1990 36 p
(Contract DAAL03-87-K-0149)
(AD-A231264; ARO-24008.3-MS) Avail: NTIS HC/MF A03 CSCL 20/2

The atomic structure of liquid-quenched amorphous Al90-Fe(x)Ce(10-x) was studied by pulsed neutron and x ray scattering. The atomic pair-density function determined by pulsed neutron and x ray scattering. The atomic pair-density function determined by pulsed neutron diffraction indicates that a significant portion of Al-Fe distances is anomalously short, while some part of the Al-Al distances is anomalously long. Both neutron and x ray scattering showed the presence of a prepeak in the structure factor. These results suggest that a strong interaction between Al and Fe modifies the structure of this glass, leading to chemical and topological short range ordering. GRA

N91-21925# State Univ. Coll. of New York, Buffalo. Dept. of Chemistry.
CRITICAL BEHAVIOR IN MAGNETIC SUPERLATTICES
T. Hai, Z. Y. Li, D. L. Lin, and Thomas F. George Jan. 1991 23 p
(Contract N00014-90-J-1193)
(AD-A231327; TR-41) Avail: NTIS HC/MF A03 CSCL 20/2

Based on the effective field theory with correlations, the critical behavior of a magnetic superlattice consisting of two different ferromagnets is examined. A simple cubic Ising model with nearest-neighbor coupling is assumed. It is found that there exists a critical value for the interface exchange coupling above which the interface magnetism appears. The critical temperature of the superlattice is studied as a function of the thickness of the constituents in a unit cell and of the exchange coupling energies in each material. A phase diagram is also given. GRA

N91-21926# International Business Machines Corp., San Jose, CA.
OBSERVATION OF SPECTRAL DIFFUSION IN CRYSTALS USING SINGLE IMPURITY MOLECULES Interim Technical Report
W. P. Ambrose and W. E. Moerner 31 Oct. 1990 15 p

(Contract N00014-84-C-0708)
(AD-A231338; IBM-RR-RJ7794; ONR-TR-27) Avail: NTIS HC/MF A03 CSCL 20/5

Early measurements of the optical absorption spectrum of a single impurity molecule in a solid at low temperatures, while intriguing, nevertheless produced insufficient signal-to-noise ratio for the observation of new physical effects. Recent advances in high-efficiency fluorescence excitation spectroscopy have removed this obstacle. For the case of pentacene molecules inp-terphenyl, both stable as well as spectrally diffusing single molecules can be observed. GRA

N91-21927# North Carolina State Univ., Raleigh.
ATOMIC LAYER EPITAXY OF SILICON, SILICON/GERMANIUM, AND SILICON CARBIDE VIA EXTRACTION/EXCHANGE PROCESSES Final Technical Report, 1 May 1989 - 30 Oct. 1990
Robert F. Davis, Salah Bedair, Jill Little, Robert Macintosh, and Joe Sumakeris Jan. 1991 33 p
(Contract N00014-89-J-1904)
(AD-A231348) Avail: NTIS HC/MF A03 CSCL 20/2

The primary focus of the research for this grant has been the atomic layer epitaxy (ALE) of Si; however, the ALE of SiC has also received serious consideration. A Computer assisted study, based on the free energy minimization of a thermodynamic system undergoing equilibrium reactions has shown that the progressive decomposition of SiH2Cl2 (the Si precursor of choice in this study) results in the products of SiCl2, H2, SiH2Cl2, HCl and Si. Moreover, above 600 C, SiCl2 is stable. Thus SiCl2 adsorbed onto the surface will not decompose. It is predicted to react with H2, forming Si on the surface. GRA

N91-21928# Cornell Univ., Ithaca, NY. Dept. of Materials Science and Engineering.
THE EFFECT OF MICROSTRUCTURE ON THE THERMAL CONDUCTIVITY OF ZnS/DIAMOND COMPOSITES
A. G. Every, Y. Tzou, D. P. Hasselman, and R. Raj 17 Jan. 1991 25 p
(Contract N00014-87-K-0527)
(AD-A231349; TR-12) Avail: NTIS HC/MF A03 CSCL 20/2

It was observed that the thermal conductivity of zinc-sulphide is increased by adding large particles of highly conducting diamond, but lowered by the addition of sub-micron size particles of diamond. This effect is explained in terms of the interfacial thermal resistance which becomes increasingly dominant as the particles become smaller (because that increases their surface to volume ratio). A phenomenological model in which the interface resistance is expressed as an effective Kapitza radius, aK, is presented. The conductivity of the composite is analyzed for different values of alpha which is defined to be equal to the Kapitza radius divided by the particle radius. GRA

N91-21929# Boston Coll., Chestnut Hill, MA. Dept. of Physics.
THEORY OF THE ELECTRONIC AND OPTICAL PROPERTIES OF SEMICONDUCTOR HETEROSTRUCTURES Final Report
David A. Broido 1990 10 p
(Contract N00014-89-J-1786)
(AD-A231438) Avail: NTIS HC/MF A02 CSCL 20/12

The research performed during the period of funding can be categorized into two areas. First, a theoretical investigation of the optical properties of strained layer quantum wells grown along the 111 crystallographic direction, and second, an examination of the far infrared response of quantum dot systems. Author (GRA)

N91-21930# Honeywell, Inc., Bloomington, MN. Sensor and System Development Center.
MONOLITHIC INTEGRATION OF SEMICONDUCTOR AND SUPERCONDUCTOR COMPONENTS Report, 4 Sep. - 31 Dec. 1990
Burgess Johnson 31 Dec. 1990 5 p
(Contract N00014-90-C-0226)
(AD-A231464) Avail: NTIS HC/MF A01 CSCL 09/1

Efforts are being made to develop transistor technology compatible with high transition temperature superconductor technology so that transistor pixel switches can be integrated with YBaCuO superconducting microbolometers in the same silicon substrate. A 4x4 matrix-addressable superconducting microbolometer array will be delivered at completion. GRA

N91-21931# Institute for Defense Analyses, Alexandria, VA.
THE NECESSITY FOR A DOD CAPABILITY IN SUPERCONDUCTING ELECTRONICS Final Report, Oct. 1988 - Nov. 1990
Leslie Cohen and Edgar A. Edelsack Nov. 1990 30 p
(Contract MDA903-89-C-0003)
(AD-A231553; IDA-P-2447; IDA/HQ-90-35764; AD-E501352)
Avail: NTIS HC/MF A03 CSCL 20/3

The technologies of superconductor electronics and hybrid superconductor-semiconductor electronics offer a unique potential for more compact systems that would afford higher performance and lower power consumption than does the present semiconductor electronics. Current efforts in superconductor electronics are discussed and probable future Department of Defense (DoD) dependence on foreign capabilities in this critical technology is critized. Selected systems on DoD needs lists are described and the establishment of programs and processing capabilities that will assure the realization of the many essential benefits offered by superconducting electronics are recommended. GRA

N91-21932# Arizona State Univ., Tempe. Dept. of Physics.
IN-SITU DIFFRACTION AND IMAGING STUDIES OF HETEROEPITAXIAL GROWTH OF SEMI-CONDUCTORS Final Report, 1 Aug. 1987 - 31 Jul. 1990
P. A. Bennett and J. A. Venables 17 Oct. 1990 9 p
(Grant AF-AFOSR-0376-87; AF Proj. 2306)
(AD-A231568; AFOSR-91-0028TR) Avail: NTIS HC/MF A02 CSCL 09/1

In-situ characterization is emphasized of the initial stages of heteroepitaxial growth of semiconductors and ultrathin film silicides using advanced instrumentation and techniques, including high resolution reflection high energy electron diffraction (RHEED), a UHV scanning electron microscope with micro-probe RHEED and a UHV scanning transmission electron microscope (UHV-STEM). Systems of interest include vicinal Si(100), germanium on silicon, and ultrathin film silicides. Specific instrument and technique developments include: Demonstration that Auger lineshapes can be used to separate coexisting silicide phases in a partially reacted ultrathin film; Demonstration that quasi-kinematic RHEED intensity calculations can be used to identify epitaxial structures; Imaging of single atomic height steps with STEM; Visualization of submonolayers of germanium and various metals using biassed secondary electron imaging; Auger imaging at the highest spatial resolution obtained anywhere. Specific scientific accomplishments include: Measurement of a kinetic phase formation diagram for contact reactions in ultrathin film silicides showing previously overlooked thickness dependence; Identification of Ni2Si-theta as a precursor structure responsible for the much studied B- to A-type transition in NiSi2 overlayers; and Demonstration that single layer steps on Si(100) are favored over double layer steps due to strain rather than entropic effects, as previously believed. GRA

N91-21933# Harry Diamond Labs., Adelphi, MD.
HOST MATERIALS FOR 4d(SUP N) AND 5d(SUP N) TRANSITION-METAL IONS Final Report
Clyde A. Morrison Dec. 1990 49 p
(AD-A231606; HDL-TM-90-20) Avail: NTIS HC/MF A03 CSCL 07/2

This report discusses ten compounds which are potential host materials for quadruply ionized elements with 4dn and 5dn electronic configurations. These compounds are ZrSiO4, HfGeO4, Li2ZrTeO6 Li2HfTeO6, Li6BeZrF12, ZrGeO4, ZrGeO8, ThSiO4, and ThGeO4 (in two forms: zircon and scheelite). The crystal-field components, A(sub nm), are calculated for the Zr, Hf, and Th sites in each of the compounds. The site symmetry is S(sub 4) or D(sub 2d), except for Li2XTeO6(X = Zr, Hf) which has C(sub 3)

symmetry. Approximate parameters, F(sup k), B(sub nm)(B, C, Dq), are given for the entire quadruply ionized 5d(sup N) configuration. GRA

N91-21934# University of Southern California, Los Angeles. Dept. of Materials Science and Engineering.
KINETIC ASPECTS OF LATTICE MISMATCH IN MOLECULAR BEAM EPITAXIAL GROWTH ON PLANAR AND PATTERNED SUBSTRATES Final Report, 15 May 1986 - 30 Apr. 1990
A. Madhukar 20 Nov. 1990 16 p
(Grant AF-AFOSR-0166-86; AF Proj. 2306)
(AD-A231636; AFOSR-91-0039TR) Avail: NTIS HC/MF A03 CSCL 20/5

This, the Final Scientific Report on AFOSR Grant 86-0166, provides the highlights of the work accomplished under the project. While the details are to be found in the publications listed as part of the report, the major accomplishments are: (1) identification of growth kinetics optimized and reproducible growth, independent of machine parameters, of GaAs/AlGaAs and GaAs/InGaAs layered structures via the usage of real time reflection high energy electron diffraction in molecular beam epitaxical growth, (2) the first realization of high mobility inverted HEMT structures, (3) demonstration of the dominant scattering from band edge discontinuity fluctuations, rather than the commonly held view of well width fluctuations in high quality GaAs/AlGaAs quantum well structures. GRA

N91-21212*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
CHEMICAL SPRAY PYROLYSIS OF Tl-Ba-Ca-Cu-O HIGH-T(SUB c) SUPERCONDUCTORS FOR HIGH-FIELD BITTER MAGNETS
L. Pierre deRochemont, John G. Zhang, Michael R. Squillante, A. M. Hermann, H. M. Duan, Robert J. Andrews (Rome Air Development Center, Hanscom AFB, MA.), and Warren C. Kelliher *In its* Aerospace Applications of Magnetic Suspension Technology, Part 2 Mar. 1991 p 607-627 (For primary document see N91-21203 13-18)
Avail: NTIS HC/MF A17 CSCL 20K

77 THERMODYNAMICS AND STATISTICAL PHYSICS

Includes quantum mechanics; theoretical physics; and Bose and Fermi statistics.

For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

N91-21935# Institute of Nuclear Physics, Krakow (Poland).
PHYSICS WITHOUT PHYSICAL CONSTANTS
E. Kapuscik 1990 10 p
(DE91-619576; INP-1482/PH) Avail: NTIS HC/MF A02

Following the general principles of both Newton's mechanics and Maxwell's electrodynamics, a new approach to basic equations of physics is presented. The new basic equations express fundamental laws of physics and are free from any physical constants. The necessary constants appear only through some kind of constitutive relations and by considering special solutions of the basic equations. The presented approach admits a new interpretation of fundamental physical constants, such as the Planck gravitational ones. DOE

N91-21936# Moscow State Univ. (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki.
HAMILTON MECHANICS FOR NONLOCAL SYSTEMS
Yu. V. Kuzmin 1989 15 p In RUSSIAN
(DE91-619625; NIIYaF-MGU-89-34-111) Avail: NTIS HC/MF A03

Hamilton mechanics for classical mechanical nonlocal systems and Schroedinger equation for quantum nonlocal systems is presented. An expression for S matrix is derived. Relations with stochastic quantization are considered. DOE

N91-21937# Moscow State Univ. (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki.
QUANTIZATION OF NONLOCAL THEORIES AND GRAVITATION
Yu. V. Kuzmin 1989 19 p In RUSSIAN
(DE91-619626; NIIYaF-MGU-89-60-137) Avail: NTIS HC/MF A03

A method of determining S matrix of nonlocal quantum field theory proceeding from the corresponding classical theory and using stochastic quantization is suggested. It is shown that the theory becomes renormalized and unitary under definite constraints on Lagrangian. These results are used to prove supernormalizability and unitarity of gravitation theory, earlier suggested by the author. DOE

N91-21938# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Lampoldshausen (Germany, F.R.). Inst. fuer Chemische Antriebe und Verfahrenstechnik.
THEORETICAL INVESTIGATION OF THE INJECTION AND EVAPORATION OF WATER IN A HYDROGEN/OXYGEN STEAM GENERATOR
Stefan Beer May 1990 68 p In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-1252)
(DLR-FB-90-20; ISSN-0171-1342; ETN-91-99029) Avail: NTIS HC/MF A04; DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 25.50 DM

For the cooling of the reaction products resulting from a stoichiometric hydrogen/oxygen combustion, water is injected normal to the gas stream. The penetration of the jet strongly influences the temperature distribution across the streaming water vapor. The penetration of the jet is calculated by using the jet shedding model. The results are compared with the data of the garden hose model. To calculate the lifetime of a water droplet in super heated stream, several models are developed. The parameters of the injection and evaporation process are varied and analyzed. ESA

80 SOCIAL SCIENCES (GENERAL)

Includes educational matters.

No abstracts in this category.

81 ADMINISTRATION AND MANAGEMENT

Includes management planning and research.

N91-21939*# Georgia Inst. of Tech., Atlanta. School of Industrial and Systems Engineering.
ACQUISITION AND PRODUCTION OF SKILLED BEHAVIOR IN DYNAMIC DECISION-MAKING TASKS Semiannual Status Report, 1 Aug. 1990 - 31 Jan. 1991
Alex Kirlik 1990 40 p
(Grant NAG2-656)
(NASA-CR-188084; NAS 1.26:188084; GIT-91-2) Avail: NTIS HC/MF A03 CSCL 05A

Ongoing research investigating perceptual and contextual influences on skilled human performance in dynamic decision making environments is discussed. The research is motivated by two general classes of findings in recent decision making research. First, many studies suggest that the concrete context in which a task is presented has strong influences on the psychological processes used to perform the task and on subsequent performance. Second, studies of skilled behavior in a wide variety of task environments typically implicate the perceptual system as

an important contributor to decision-making performance, either in its role as a mediator between the current decision context and stored knowledge, or as a mechanism capable of directly initiating activity through the development of a 'trained eye.' Both contextual and perceptual influences place limits on the ability of traditional utility-theoretic accounts of decision-making to guide display design, as variance in behavior due to contextual factors or the development of a perceptual skill is left unexplained. The author outlines a framework in which to view questions of perceptual and contextual influences on behavior and describe an experimental task and analysis technique which will be used to diagnose the possible role of perception in skilled decision making performance. Author

82 DOCUMENTATION AND INFORMATION SCIENCE

Includes information management; information storage and retrieval technology; technical writing; graphic arts; and micrography.

For computer documentation see *61 Computer Programming and Software.*

N91-21940*# Houston Univ., Clear Lake, TX. Software Engineering Professional Education Center.
SEPEC CONFERENCE PROCEEDINGS: HYPERMEDIA AND INFROMATION RECONSTRUCTION. AEROSPACE APPLICATIONS AND RESEARCH DIRECTIONS
1990 164 p Conference held in Houston, TX, 3-5 Dec. 1990 (Contract NCC9-16)
(NASA-CR-187935; NAS 1.26:187935) Avail: NTIS HC/MF A08 CSCL 05B

Papers presented at the conference on hypermedia and information reconstruction are compiled. The following subject areas are covered: real-world hypermedia projects, aerospace applications, and future directions in hypermedia research and development. For individual titles, see N91-21941 through N91-21954.

N91-21941*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
EXPERIMENT DOCUMENT INFORMATION SYSTEM (EDIS) EVOLUTION
Jane Moorhead and Henry Brans *In* Houston Univ., SEPEC Conference Proceedings: Hypermedia and Information Reconstruction. Aerospace Applications and Research Directions 1990 6 p (For primary document see N91-21940 13-82)
Avail: NTIS HC/MF A08 CSCL 05B

The EDIS is the second generation of a system designed to produce and control a document containing large amounts of text in combination with tables and graphs of mathematical/scientific data. The first generation system proved the concept, but the slow, unfriendly user interface resulted in an effort to find an off-the-shelf product to improve the interface capability while maintaining the system requirements. The basic design of that first system was combined with the hypertext concepts inherent in HyperCard to generate the most usable EDIS. Currently in the latter stages of design, the EDIS promises to be the first step in the automation of the process required for defining complete packages of Life Sciences experiments for the Shuttle missions. Author

N91-21942*# Hudson Products Corp., NY.
ENGINEERING SOFTWARE DEVELOPMENT WITH HYPERCARD **c61**
Robert J. Darko *In* Houston Univ., SEPEC Conference Proceedings: Hypermedia and Information Reconstruction. Aerospace Applications and Research Directions 1990 9 p (For primary document see N91-21940 13-82)
Avail: NTIS HC/MF A08 CSCL 09B

The successful and unsuccessful techniques used in the development of software using HyperCard are described. The viability of the HyperCard for engineering is evaluated and the future use of HyperCard by this particular group of developers is discussed. Author

N91-21943*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
LIFE SCIENCES ON-LINE: A STUDY IN HYPERMEDIA APPLICATION
Linda A. Christman, Nam V. Hoang, and David R. Proctor *In* Houston Univ., SEPEC Conference Proceedings: Hypermedia and Information Reconstruction. Aerospace Applications and Research Directions 1990 11 p (For primary document see N91-21940 13-82)
Avail: NTIS HC/MF A08 CSCL 05B

The main objective was to determine the feasibility of using a computer-based interactive information recall module for the Life Sciences Project Division (LSPD) at NASA, Johnson Space Center. LSPD personnel prepare payload experiments to test and monitor physiological functions in zero gravity. Training refreshers and other types of online help are needed to support personnel in their tasks during mission testing and in flight. Results of a survey of other hypermedia and multimedia developers and lessons learned by the developer of the LSPD prototype module are presented. Related issues and future applications are also discussed and further hypermedia development within the LSPD is recommended. Author

N91-21944*# Air Force Human Resources Lab., Brooks AFB, TX.
COMPUTER-ASSISTED KNOWLEDGE ACQUISITION FOR HYPERMEDIA SYSTEMS
Kurt Steuck *In* Houston Univ., SEPEC Conference Proceedings: Hypermedia and Information Reconstruction. Aerospace Applications and Research Directions 1990 6 p (For primary document see N91-21940 13-82)
Avail: NTIS HC/MF A08 CSCL 05B

The usage of procedural and declarative knowledge to set up the structure or 'web' of a hypermedia environment is described. An automated knowledge acquisition tool was developed that helps a knowledge engineer elicit and represent an expert's knowledge involved in performing procedural tasks. The tool represents both procedural and prerequisite, declarative knowledge that supports each activity performed by the expert. This knowledge is output and subsequently read by a hypertext scripting language to generate the link between blank, but labeled cards. Each step of the expert's activity and each piece of supporting declarative knowledge is set up as an empty node. An instructional developer can then enter detailed instructional material concerning each step and declarative knowledge into these empty nodes. Other research is also described that facilitates the translation of knowledge from one form into a form more readily useable by computerized systems. Author

N91-21945*# Houston Univ., Clear Lake, TX.
A MODEL FOR ADDRESSING NAVIGATION LIMITATIONS AND METACOGNITIVE CONSTRAINTS IN HYPERMEDIA TRAINING SYSTEMS
Glenn B. Freedman *In its* SEPEC Conference Proceedings: Hypermedia and Information Reconstruction. Aerospace Applications and Research Directions 1990 6 p (For primary document see N91-21940 13-82)
Avail: NTIS HC/MF A08 CSCL 05B

A model for addressing navigation limitations and metacognitive constraints in hypermedia training systems is presented in the form of the viewgraphs. The following subject areas are covered: samples of software and people problems; system design; and hypermedia training system. Y.S.

N91-21946*# Search Technology, Inc., Norcross, GA.
SEVEN WAYS TO MAKE A HYPERTEXT PROJECT FAIL
Robert J. Glushko *In* Houston Univ., SEPEC Conference Proceedings: Hypermedia and Information Reconstruction.

Aerospace Applications and Research Directions 1990 6 p (For primary document see N91-21940 13-82)
Avail: NTIS HC/MF A08 CSCL 05B

Hypertext is an exciting concept, but designing and developing hypertext applications of practical scale is hard. To make a project feasible and successful 'hypertext engineers' must overcome the following problems: (1) developing realistic expectations in the face of hypertext hype; (2) assembling a multidisciplinary project team; (3) establishing and following design guidelines; (4) dealing with installed base constraints; (5) obtaining usable source files; (6) finding appropriate software technology and methods; and (7) overcoming legal uncertainties about intellectual property concerns. Author

N91-21947*# Warren-Forthought, Inc., Angleton, TX.
THE OBJECT THE METAPHOR THE POWER AND EVERGREEN OR THE EIGHTH WAY TO MAKE A HYPERMEDIA PROJECT FAIL
Bruce A. Warren *In* Houston Univ., SEPEC Conference Proceedings: Hypermedia and Information Reconstruction. Aerospace Applications and Research Directions 1990 5 p (For primary document see N91-21940 13-82)
Avail: NTIS HC/MF A08 CSCL 05B

A patented software technique is described that is necessary and sufficient to keep hypermedia data bases current with the manufacturing technology. The technique proved its validity in four years of use in petrochemical plants. This technique is based on the following principles: (1) the data base must be object structured, i.e., all components must retain visible individuality; (2) the author must be seeing and experiencing the multimedia data objects as he creates; and (3) the hypermedia tools must possess power in the form of unlimited capacity. Y.S.

N91-21948*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
HYPERMEDIA AND INTELLIGENT TUTORING APPLICATIONS IN A MISSION OPERATIONS ENVIRONMENT
Troy Ames and Clifford Baker (Carlow Associates, Inc., Fairfax, VA.) *In* Houston Univ., SEPEC Conference Proceedings: Hypermedia and Information Reconstruction. Aerospace Applications and Research Directions 1990 17 p (For primary document see N91-21940 13-82)
Avail: NTIS HC/MF A08 CSCL 05B

Hypermedia, hypertext and Intelligent Tutoring System (ITS) applications to support all phases of mission operations are investigated. The application of hypermedia and ITS technology to improve system performance and safety in supervisory control is described - with an emphasis on modeling operator's intentions in the form of goals, plans, tasks, and actions. Review of hypermedia and ITS technology is presented as may be applied to the tutoring of command and control languages. Hypertext based ITS is developed to train flight operation teams and System Test and Operation Language (STOL). Specific hypermedia and ITS application areas are highlighted, including: computer aided instruction of flight operation teams (STOL ITS) and control center software development tools (CHIMES and STOL Certification Tool). Y.S.

N91-21949*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
INTEGRATING KNOWLEDGE AND CONTROL INTO HYPERMEDIA-BASED TRAINING ENVIRONMENTS: EXPERIMENTS WITH HYPERCLIPS
Randall W. Hill, Jr. *In* Houston Univ., SEPEC Conference Proceedings: Hypermedia and Information Reconstruction. Aerospace Applications and Research Directions 1990 10 p (For primary document see N91-21940 13-82)
Avail: NTIS HC/MF A08 CSCL 05B

The issues of knowledge representation and control in hypermedia-based training environments are discussed. The main objective is to integrate the flexible presentation capability of hypermedia with a knowledge-based approach to lesson discourse management. The instructional goals and their associated concepts are represented in a knowledge representation structure called a 'concept network'. Its functional usages are many: it is used to control the navigation through a presentation space, generate tests for student evaluation, and model the student. This architecture was implemented in HyperCLIPS, a hybrid system that creates a bridge between HyperCard, a popular hypertext-like system used for building user interfaces to data bases and other applications, and CLIPS, a highly portable government-owned expert system shell. Author

N91-21950*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
GERM AS A TOOL FOR SPACE STATION DOCUMENTATION
Ken Crouse and Charles Hardwick (Houston Univ., Clear Lake, TX.) *In* Houston Univ., SEPEC Conference Proceedings: Hypermedia and Information Reconstruction. Aerospace Applications and Research Directions 1990 11 p (For primary document see N91-21940 13-82)
Avail: NTIS HC/MF A08 CSCL 05B

GERM as a tool for space station documentation is presented in the form of viewgraphs. The following subject areas are covered: problem statement, hypermedia as a tool for documentation, description of GERM, technical approach, application development, and results and conclusions. Y.S.

N91-21951*# Boston Coll., Chestnut Hill, MA. School of Management.
AUTOMATING HYPERTEXT FOR DECISION SUPPORT
Michael Bieber *In* Houston Univ., SEPEC Conference Proceedings: Hypermedia and Information Reconstruction. Aerospace Applications and Research Directions 1990 11 p (For primary document see N91-21940 13-82)
Avail: NTIS HC/MF A08 CSCL 05B

A decision support system (DSS) shell is being constructed that can support applications in a variety of fields, e.g., engineering, manufacturing, finance. The shell provides a hypertext-style interface for 'navigating' among DSS application models, data, and reports. The traditional notion of hypertext had to be enhanced. Hypertext normally requires manually, pre-defined links. A DSS shell, however, requires that hypertext connections to be built 'on the fly'. The role of hypertext is discussed in augmenting DSS applications and the decision making process. Also discussed is how hypertext nodes, links, and link markers tailored to an arbitrary DSS application were automatically generated. Author

N91-21952*# Houston Univ., Clear Lake, TX. Advanced Knowledge Transfer Project.
HYPERMEDIA AS MEDIUM
Christopher J. Dede *In its* SEPEC Conference Proceedings: Hypermedia and Information Reconstruction. Aerospace Applications and Research Directions 1990 11 p (For primary document see N91-21940 13-82)
Avail: NTIS HC/MF A08 CSCL 05B

Claims and rebuttals that hypermedia (the associative, nonlinear interconnection of multimedia materials) is a fundamentally innovative means of thinking and communicating are described. This representational architecture has many advantages that make it a major advance over other media; however, it also has several intrinsic problems that severly limits its effectiveness as a medium. These advantages and limits in applications are discussed. Y.S.

N91-21953*# IBM Research Lab., Yorktown Heights, NY. Interactive Media Project.
HYPERMEDIA = HYPERCOMMUNICATION
Mark R. Laff *In* Houston Univ., SEPEC Conference Proceedings: Hypermedia and Information Reconstruction. Aerospace Applications and Research Directions 1990 5 p (For primary document see N91-21940 13-82)
Avail: NTIS HC/MF A08 CSCL 05B

New hardware and software technology gave application designers the freedom to use new realism in human computer interaction. High-quality images, motion video, stereo sound and music, speech, touch, gesture provide richer data channels between

the person and the machine. Ultimately, this will lead to richer communication between people with the computer as an intermediary. The whole point of hyper-books, hyper-newspapers, virtual worlds, is to transfer the concept and relationships, the 'data structure', from the mind of creator to that of user. Some of the characteristics of this rich information channel are discussed, and some examples are presented. Y.S.

N91-21954*# Houston Univ., Clear Lake, TX.
FROM KNOWLEDGE PRESENTATION TO KNOWLEDGE REPRESENTATION TO KNOWLEDGE CONSTRUCTION: FUTURE DIRECTIONS FOR HYPERMEDIA
David B. Palumbo *In its* SEPEC Conference Proceedings: Hypermedia and Information Reconstruction. Aerospace Applications and Research Directions 1990 18 p (For primary document see N91-21940 13-82)
Avail: NTIS HC/MF A08 CSCL 05B

Relationships between human memory systems and hypermedia systems are discussed with particular emphasis on the underlying importance of associational memory. The distinctions between knowledge presentation, knowledge representation, and knowledge constructions are addressed. Issues involved in actually developing individualizable hypermedia based knowledge construction tools are presented. Y.S.

N91-21955*# Houston Univ., Clear Lake, TX. Software Engineering Professional Education Center.
SEPEC CONFERENCE PROCEEDINGS: HYPERMEDIA AND INFORMATION RECONSTRUCTION. AEROSPACE APPLICATIONS AND RESEARCH DIRECTIONS. ADDENDUM
1990 80 p Conference held in Houston, TX, 3-5 Dec. 1990 (Contract NCC9-16)
(NASA-CR-187936; NAS 1.26:187936) Avail: NTIS HC/MF A05 CSCL 05B

The papers presented at the conference on hypermedia and information reconstruction are compiled. The following subject areas are covered: hypertext, typographic man, and the notion of literacy; a knowledge base browser using hypermedia; Ai GERM - a logic programming front end for GERM; and HEAVENS system for software artifacts. For individual titles, see N91-21956 through N91-21958.

N91-21956*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
A KNOWLEDGE BASE BROWSER USING HYPERMEDIA
Tony Pocklington (McDonnell-Douglas Space Systems Co., Houston, TX.) and Lui Wang *In* Houston Univ., SEPEC Conference Proceedings: Hypermedia and Information Reconstruction. Aerospace Applications and Research Directions. Addendum 1990 14 p (For primary document see N91-21955 13-82)
Avail: NTIS HC/MF A05 CSCL 05B

A hypermedia system is being developed to browse CLIPS (C Language Integrated Production System) knowledge bases. This system will be used to help train flight controllers for the Mission Control Center. Browsing this knowledge base will be accomplished either by having navigating through the various collection nodes that have already been defined, or through the query languages. Author

N91-21957*# Microelectronics and Computer Technology Corp., Austin, TX.
AIGERM: A LOGIC PROGRAMMING FRONT END FOR GERM **c61**
Safaa H. Hashim *In* Houston Univ., SEPEC Conference Proceedings: Hypermedia and Information Reconstruction. Aerospace Applications and Research Directions. Addendum 1990 18 p (For primary document see N91-21955 13-82)
Avail: NTIS HC/MF A05 CSCL 09B

AiGerm (Artificially Intelligent Graphical Entity Relation Modeler) is a relational data base query and programming language front end for MCC (Mission Control Center)/STP's (Space Test Program) Germ (Graphical Entity Relational Modeling) system. It is intended as an add-on component of the Germ system to be used for navigating very large networks of information. It can also function as an expert system shell for prototyping knowledge-based systems. AiGerm provides an interface between the programming language and Germ. Y.S.

N91-21958*# Bell Communications Research, Inc., Piscataway, NJ.
HEAVENS SYSTEM FOR SOFTWARE ARTIFACTS **c61**
Paul Matthews *In* Houston Univ., SEPEC Conference Proceedings: Hypermedia and Information Reconstruction. Aerospace Applications and Research Directions. Addendum 1990 15 p (For primary document see N91-21955 13-82)
Avail: NTIS HC/MF A05 CSCL 09B

The HEAVENS system is a workstation-based collection of software for analyzing, organizing, and viewing software artifacts. As a prototype, the system was used for visualizing source code structure, analyzing dependencies, and reconstructing to simplify maintenance. The system was also used in the early stages of software design to organize and relate design objects, maintain design documentation, and provide ready-made framework for later coding. Author

N91-21959*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
NASA/DOD AEROSPACE KNOWLEDGE DIFFUSION RESEARCH PROJECT. PAPER 9: INFORMATION INTERMEDIARIES AND THE TRANSFER OF AEROSPACE SCIENTIFIC AND TECHNICAL INFORMATION (STI). A REPORT FROM THE FIELD
J. D. Eveland (Claremont Graduate School, CA.) and Thomas E. Pinelli 9 Apr. 1991 16 p Submitted for publication Prepared in cooperation with Department of Defense, Washington, DC, and Indiana Univ., Bloomington
(NASA-TM-103384; NAS 1.15:103384) Avail: NTIS HC/MF A03 CSCL 05B

From the NASA/DOD survey data, there can be no way of inferring what strategy for knowledge transfer is best; indeed, given the fact that the respondents were all presumably well qualified professionals, the data tend to call into serious question the idea that any one model might meet the needs of more than a distinct minority of possible users. The evidence to date appears to reinforce the concept that different information environments take many different shapes, and interact with each other and with formal data transmission sources in many different and equally valuable ways. Any overall strategy for improving the effectiveness and efficiency of scientific and technical information sharing must take this divergence into account, and work toward the creation of systems that reinforce true interactive knowledge utilization rather than simply disseminating data. Author

N91-21960# National Geophysical Data Center, Boulder, CO.
NATIONAL GEOPHYSICAL DATA CENTER: PROGRAMS AND SERVICES (25TH ANNIVERSARY 1965-1990)
Jul. 1990 103 p
(PB91-123356) Avail: NTIS HC/MF A06 CSCL 05B

Brief reviews of the following programs and services are contained: Climate and Global Change Program; Marine Geology Program; Ocean Drilling Data Program; Marine Geophysics Program; Bathymetry Program; Topography Program; Land Gravity Program; Aeromagnetic Program; Integrated Land Geophysics Program; Seismology Program; Tsunami Program; Geomagnetism Program; Solar and Upper Atmospheric Physics Program; ionospheric Physics Program; Numerical Modeling in Solar-Terrestrial Physics; Snow and Ice Program; Satellite Data Programs; Satellite Anomalies Program; National and International Cooperative Programs; and Outreach Activities. The three appendices discuss the NGDC organizational structure, historical highlights, and acronyms. GRA

N91-21961# MBC Applied Environmental Sciences, Inc., Costa Mesa, CA.
THIRD INFORMATION TRANSFER MEETING Final Report
Kathryn L. Mitchell, ed. Jun. 1990 229 p Meeting held in

Anchorage, AK, 30 Jan. - 1 Feb. 1990
(Contract DI-14-12-0001-30297)
(PB91-123922; OCS/MMS-90/0041) Avail: NTIS HC/MF A11 CSCL 05B

Summaries of the presentations and transcripts of the discussion sessions of the Third Information Transfer Meeting (ITM) are presented. These ITMs provide a means of exchange of information among Federal and State agencies, industry, academia, and the general public. The ITM include 13 talks on marine mammals, 7 talks on sea birds, and 8 social and economic presentations. GRA

N91-21962# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
ACCESS AND OPERATOR METHODS FOR THE TRITON NESTED RELATIONAL DATABASE SYSTEM M.S. Thesis
Tina M. Harvey 13 Dec. 1990 127 p
(AD-A230608; AFIT/GCS/ENG/90D-06) Avail: NTIS HC/MF A07 CSCL 12/6

Unique database requirements in the realm of non-standard applications such as computer-aided design (CAD), computer-aided software engineering (CASE), and office information systems (OIS) have driven the development of new data models and database systems based on these new models. In particular, the goal of these new database systems is to exploit the advantages of complex data models that are more efficient (in terms of time and space) than their relationship counterparts. This research effort describes the relational design and implementation of the Triton nested relational database system which is a prototype system based on the nested relational data model. Triton is intended to be used as the backed storage component for some non-standard application. To quickly prototype the system, the EXODUS extensible database system is used in the development of Triton. The research presented in this document focuses on Triton's operator and access methods, and compares the performance of the nested relational model versus the relational model using these methods. In addition, the effectiveness of the EXODUS extensible database toolkit is evaluated. GRA

N91-21963# Defense Mapping Agency Systems Center, Fairfax, VA.
KNOWLEDGE BASE SYSTEMS IN DMA'S DIGITAL PRODUCTION SYSTEM
Maria M. Gruenewald and Jeffrey L. Kretsch 1990 9 p
(AD-A230771) Avail: NTIS HC/MF A02 CSCL 12/7

The Digital Production System (DPS) is an end-to-end system with softcopy source as primary input and Defense Mapping Agency cartographic products as output. Within the DPS, there are Knowledge Based Systems (KBSs) which support the overall process in the planning of production, stereo extraction of cartographic features, and the generation of products. GRA

N91-21964# Sandia National Labs., Albuquerque, NM.
ADMINISTRATIVE INFORMATION SYSTEMS PLAN, FY 1991 - FY 1995
R. J. Detry and L. H. Pitts Jan. 1991 76 p
(Contract DE-AC04-76DP-00789)
(DE91-008072; SAND-90-2993) Avail: NTIS HC/MF A05

In FY90 important milestones from past Administrative Information Systems (AIS) plans were realized. The first phase of the Payroll migration was implemented early in the year. This event signified the completion of a major migration milestone and the transition of the Laboratory Information Systems (LIS) machine to a production environment. The Access and Clearance System (A and CS) system and several early deliverables from other migration projects were also implemented during the year. FY91 promises to be another challenging year for those involved with administrative information systems. Aggressive schedules are in effect for the migration projects; the Financial Migration, Human Resources (HR) Migration, and Integrated Procurement System Replacement (IPS/R) efforts will deliver major system components this year. The administrative computing consolidation is underway and will be completed early in FY91. Consolidating computing hardware resources will provide adequate resources and better systems support for the entire AIS community. DOE

N91-21965# Sandia National Labs., Albuquerque, NM.
RELATIONAL DATABASES WITH NIAM MODELS BID SO LONG TO TOP-DOWN DESIGNS
D. S. Eaton 1991 65 p Presented at the Southwest Regional INGRES Users Association Meeting, Albuquerque, 28 Feb. - 1 Mar. 1991
(Contract DE-AC04-76DP-00789)
(DE91-009191; SAND-91-0517C; CONF-910276-4) Avail: NTIS HC/MF A04

Relational databases have many advantages over former hierarchical and network systems. The most important advantage is their ease of modification. This leads designers to a new approach, which has been found to be very useful in building an information system of corporate-wide shared data. This approach is a phased bottom-up design and application development which is supported by an information modeling method called NIAM (Nijssen's Information Analysis Method). NIAM is not well known in the USA, but is widely used in Europe. An introduction to the NIAM approach and its advantages will be followed by examples of models and their corresponding relational database designs that were developed in step-wise fashion at the company. Since NIAM algorithms yield tables in fifth normal form, the relational systems are implemented for optimum update capabilities and enforceable referential integrity. DOE

N91-21966*# Houston Univ., Clear Lake, TX. Research Inst. for Computing and Information Systems.
XTP FOR THE NASA SPACE STATION
Alfred C. Weaver (Virginia Univ., Charlottesville.) Mar. 1990 15 p
(Contract NCC9-16)
(NASA-CR-188087; NAS 1.26:188087) Avail: NTIS HC/MF A03 CSCL 05B

The NASA Space Station is a truly international effort; therefore, its communications systems must conform to established international standards. Thus, NASA is requiring that each network-interface unit implement a full suite of ISO protocols. However, NASA is understandably concerned that a full ISO stack will not deliver performance consistent with the real-time demands of Space Station control systems. Therefore, as a research project, the suitability of the Xpress transfer protocol (XTP) is investigated along side a full ISO stack. The initial plans for implementing XTP and comparing its performance to ISO TP4 are described. Author

N91-21967# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
IDENTIFICATION OF INFORMATION NEEDS IN A RESEARCH INSTITUTE M.S. Thesis [IDENTIFICACAO DE NECESSIDADES DE INFORMACAO EM UM INSTITUTO DE PESQUISA]
Elizabeth Schuetzer Oct. 1990 130 p In PORTUGUESE; ENGLISH summary
(INPE-5154-TDL/425) Avail: NTIS HC/MF A07

The objective is to demonstrate the importance of information needs identification to the planning and development of information systems used by top management in a research institute. A bibliographical survey was done on the role of information systems as supports to the administration process, on some methods of planning and development, and on the Critical Success Factors method. The results are analyzed. Author

N91-21968# California Univ., Berkeley. Lawrence Berkeley Lab.
PROMOTING A HEALTHY SKEPTICISM WITH REGARD TO INFORMATION PROCESSING
D. F. Stevens Jan. 1991 13 p Presented at the 7th International Conference and Exhibition on Information Security: Creating Confidence in Information Processing, Brighton, England, 15-17 May 1991

(Contract DE-AC03-76SF-00098)
(DE91-007697; LBL-30110; CONF-9105129-1) Avail: NTIS HC/MF A03

Computer security professionals and members of collaborative research environments have conflicting objectives with respect to computer and network access, and different understandings of what constitutes a reasonable organization. These differences create tension between the two communities and make the achievement of an acceptable level of security a matter of some difficulty in such environments. We consider some of the differences and present the elements of a program aimed at promoting sensible computer and network security in the research milieu. DOE

N91-21969# Defense Technical Information Center, Alexandria, VA.
DATA ELEMENT DICTIONARY: TECHNICAL REPORT DATABASE, PART 1
Nathan Rosenbaum Feb. 1991 328 p
(AD-A230836; DTIC/TR-91-1-Pt-1) Avail: NTIS HC/MF A15 CSCL 12/5

The Data Element Dictionary is part of DTIC's effort to control and standardized information that is collected and contained in its databases. This revised edition of the Dictionary, originally published in 1980, describes the data contained in the Technical Report Database. The Dictionary will be expanded as additional databases are studied. GRA

N91-21970# Royal Norwegian Council for Scientific and Industrial Research, Kjeller.
[OPERATION, MAINTENANCE, AND RESEARCH ACTIVITIES AT NORSAR, NORESS, AND ARCESS] Semiannual Technical Report, 1 Oct. 1989 - 31 Mar. 1990
L. B. Loughran Jun. 1990 113 p
(Contract F08600-89-C-0005; ARPA Order 4138)
(AD-A230874; NORSAR-CONTRIB-421) Avail: NTIS HC/MF A06 CSCL 17/10

This Summary describes the operation, maintenance and research activities at the Norwegian Seismic Array (NORSAR), the Norway Regional Seismic Array (NORESS) and the Arctic Regional Seismic Array (ARCESS) for the reporting period. It also presents statistics from operation of the Intelligent Monitoring System (IMS). Data from the Finnish Experimental Seismic Array (FINESA) are also being recorded and processed at the NORSAR Data Center as well as in Helsinki, and results from NORSAR processing of these data are reported. The NORSAR detection processing system has operated throughout the period with an average uptime of 91.8 as compared to 94.9 for the previous reporting period. A total of 1648 seismic events were reported in the NORSAR monthly seismic bulletin. Performance of the continuous alarm system and the automatic bulletin transfer by telex of AFTAC has been satisfactory. Processing of requests for full NORSAR/NORESS data on magnetic tapes has progressed according to established schedules. GRA

N91-21971# Defense Technical Information Center, Alexandria, VA.
SOURCE HEADER LIST. VOLUME 1: A THROUGH K Annual Report, Nov. 1989 - Sep. 1990
Loretta M. Brown Dec. 1990 567 p Supersedes DTIC/TR-89/21-Vol-1
(AD-A231000; DTIC/TR-90/3-Vol-1; DTIC/TR-89/21-Vol-1)
Avail: NTIS HC/MF A24 CSCL 05/2

This publication is the first of two volumes of an alphabetically arranged compilation of corporate author names used by the Defense Technical Information Center in the DTIC database system. Each source name is assigned a 6-digit numeric code for computer input and retrieval purposes plus a 4-digit alphanumeric geopolitical code and an alphanumeric type code. Source names displayed are included as data elements in this Technical Report, Work Unit Information System and Independent Research and Development databases maintained by DTIC. GRA

N91-21972# Defense Technical Information Center, Alexandria, VA.
SOURCE HEADER LIST. VOLUME 2: L THROUGH Z Annual Report, Nov. 1989 - Sep. 1990
Loretta M. Brown Dec. 1990 573 p Supersedes DTIC/TR-89/21-Vol-2
(AD-A231001; DTIC/TR-90/3-Vol-2; DTIC/TR-89/21-Vol-2)
Avail: NTIS HC/MF A24 CSCL 05/2

This publication is the second of two volumes of an alphabetically arranged compilation of corporate author names used by the Defense Technical Information Center in the DTIC database system. Each source name is assigned a 6-digit numeric code for computer input and retrieval purposes plus a 4-digit alphanumeric geopolitical code and an alphanumeric type code. Source names displayed are included as data elements in this Technical Report, Work Unit Information System and Independent Research and Development databases maintained by DTIC. GRA

N91-21973# Army Engineer Topographic Labs., Fort Belvoir, VA.
SCAN-LINE METHODS IN SPATIAL DATA SYSTEMS Scientific Paper, 23-27 Jul. 1990
Michael McDonnell 4 Sep. 1990 12 p
(AD-A231165; ETL-R-152) Avail: NTIS HC/MF A03 CSCL 12/6

This paper examines a method of manipulating data in grid cell spatial data management systems such as Geographic Information Systems (GIS) and digital cartographic systems. While scan line methods have advantages when used only in traditional GIS operations such as manipulation of region polygons (binary overlays), much of this paper discusses digital imagery, digitized map backgrounds, and other types of pictorial or multibit data. This is because the integration of these kinds of data with GIS will become more prevalent and because scan-line techniques are especially useful for pictorial data. The incorporation of remote sensing data into GIS is a major current issue. Jensen notes that the full potential of remote sensing and GIS can best be achieved if the technologies are integrated. Remote sensing data consists mostly of digitized photography, so it is important to be able to handle photographic data in a GIS. Modern digital cartography entails the handling of ever-larger data sets. And it may take many of these data sets to cover a region of interest. This amount of data cannot be handled well on present computer systems, and extrapolation of computer capabilities shows that handling large amounts of data will be difficult for many years to come. GRA

N91-21974# Jackson State Univ., MS. Center for Spatial Data Research and Applications.
GEOGRAPHIC INFORMATION SYSTEMS: A PRIMER Final Report
Bruce E. Davis and Kevin L. Schultz Oct. 1990 142 p
(Contract DACW39-89-M-5054)
(AD-A231465; WES/CR/ITL-90-1) Avail: NTIS HC/MF A07 CSCL 08/6

GIS offer a computer-based method for systematically recording, storing, retrieving, analyzing, and portraying geographically referenced information. New techniques for spatial analyses are also provided that range from multi-layer stacking and interpretation of georeferenced data to automatic construction of new coverages (digital maps) produced by intricate and analytical routines. Developmental trends currently under way indicate that merger of computer-assisted cartography (CAC), computer aided design and drafting (CADD), and GIS technologies is taking place under the umbrella of spatial data analysis and management. Segregation of the technologies is becoming less and less apparent, and the capabilities provided therein are becoming more and more interdependent. As a result, GIS is not currently unified in a well-defined disciplinary niche and suffers from a serious lack of definition of terminology, concepts, and standards. A primer is presented for middle and upper management personnel who may be considering applications of GIS hardware and software with intent to apply GIS technology in solution of local problems.

Concepts are defined, and an attempt is made to identify some of the more generally accepted applications for GIS technology. A glossary of terms and a bibliography of relevant literature are included in an attempt to stop some of the confusion that surrounds GIS technology. GRA

83 ECONOMICS AND COST ANALYSIS

Includes cost effectiveness studies.

N91-21975# European Space Agency, Paris (France).
THE INDIRECT ECONOMIC EFFECTS OF THE EUROPEAN SPACE AGENCY PROGRAMS [LES EFFETS ECONOMIQUES INDIRECTS DES PROGRAMMES DE L'AGENCE SPATIALE EUROPEENNNE]
T. D. Guyenne, ed. Oct. 1990 28 p In FRENCH Original contains color illustrations
(ESA-BR-63; ISBN-92-9092-031-9; ETN-91-98976) Copyright Avail: NTIS HC/MF A03

The influence of ESA on the industrial activity in the technological, commercial and organizational area is studied. New products developed with technologies achieved for an ESA program are considered; the reliability and the quality of spatial programs is a good reference for manufacturers; the rational and efficient methods of the ESA programs are shown to be useful for other projects and to improve the know how and the added value. The information was collected by direct industrial enquiries. It is concluded that this report clarifies some aspects of the behavior and the industrial needs of the spatial activity. ESA

N91-21976# Imatran Voima Oy, Helsinki (Finland).
AN INTRODUCTION TO FINANCIAL AND ECONOMIC ANALYSIS: POWER PROJECTS IN INDUSTRIALIZING AND NON-INDUSTRIALIZED COUNTRIES
Mikael Norrbaeck 1990 54 p
(DE91-752995; IVO-B-03/90; ISBN-951-8928-36-3; ISSN-0782-9221) Avail: NTIS HC/MF A04

A view is given of the different evaluation methods and their use is improved in the preparation of project feasibility studies. The literature is surveyed in the subject mainly provided by international financial institutions and development agencies. The conventional project evaluation methods, especially the internal rate of return and the net present value methods, are useful when preparing project feasibility studies. Sensitivity analysis is proved to be useful in evaluation of projects, where the basic information is uncertain. Risk analysis can be used in large projects involving many risks. The financial analysis was the starting point for the economic appraisal, but factors that lead to distorted prices were adjusted. Factors that cause problems for the evaluation are, for example, inflation, overvaluation of currency, wages and under-employment. The price distortion is adjusted by shadow pricing. The last section considers the central problem which arises when appraising the economic worth of new types of generating plant; namely, that the operating costs of each chosen plant, over its lifetime, both depend upon and help to determine the choice of new plant during that period. The background of the problem is considered and a graphical presentation is made of the method. The feasibility of energy projects is usually very sensitive to the price of electricity. The shadow price of electricity is the alternative cost for production or the long run marginal cost. The social impact (income distribution etc.) of the projects can be evaluated in theory, but in practice the statistics normally available are insufficient for rigorous analysis. DOE

84 LAW, POLITICAL SCIENCE AND SPACE POLICY

Includes NASA appropriation hearings; aviation law; space law and policy; international law; international cooperation; and patent policy.

N91-21977# Committee on Commerce, Science, and Transportation (U.S. Senate).
NASA AUTHORIZATIONS
Washington GPO 1990 619 p Hearings before the Committee on Commerce, Science, and Transportation, 101st Congress, 2d Session, 9 Mar., 28 Mar., 3 Apr., 3 May, 10 May, and 15 May 1990
(S-Hrg-101-981; GPO-30-598) Avail: Subcommittee on Scoience, Technology, and Space, Senate, Washington, DC HC free; also available SOD HC $17.00 as 552-070-09349-4

Presented are the hearings on the National Aeronautics and Space Administration's fiscal year 1991 budget request before the Subcommittee on Science, Technology, and Space of the Committee on Commerce, Science, and Transportation of the U.S. Senate of the 101st Congress, second session. Oral and written testimony and submittals for the record are included. The six days of hearings covered an overview of NASA, the space shuttles and space station, the Mission to the Planet Earth, aeronautics and space technology, space science and applications, and commercial space programs. For individual titles, see N91-21978 through N91-21983.

N91-21978# Committee on Commerce, Science, and Transportation (U.S. Senate).
NASA OVERVIEW
In its NASA Authorizations 1990 p 1-55 (For primary document see N91-21977 13-84)
Avail: Subcommittee on Scoience, Technology, and Space, Senate, Washington, DC HC free; also available SOD HC $17.00 as 552-070-09349-4

Opening statements by subcommittee members and a prepared statement by the National Aeronautics and Space Administration's Administrator are followed by responses to questions submitted to NASA prior to the hearings. Oral testimony included discussions on the necessity of funding stability, explanations of budget increases and how the increases would be funded, the importance of starting new projects (only 2 percent of the budget), various critical reports written about NASA's operations, and how NASA might better stimulate the U.S. economy. J.P.S.

N91-21979# Committee on Commerce, Science, and Transportation (U.S. Senate).
NASA SPACE SHUTTLE/SPACE STATION
In its NASA Authorizations 1990 p 57-120 (For primary document see N91-21977 13-84)
Avail: Subcommittee on Scoience, Technology, and Space, Senate, Washington, DC HC free; also available SOD HC $17.00 as 552-070-09349-4

Opening statements by subcommittee members and a prepared statement by the National Aeronautics and Space Administration's Associate Administrator for the Office of Space Flight are followed by responses to questions submitted to NASA prior to the hearings. Discussions stressed the necessity of funding stability to the safety and continued use of space shuttles, and the importance of shuttles to other NASA programs. In presenting the budget request for the Space Station Freedom, NASA Management emphasized that NASA's objectives have not changed, that progress has been substantial, that adjustments to the program have not affected its basic integrity, and that full funding for FY 1991-1993 is essential, not only to complete the Space Station on schedule and keep costs down, but also to avoid significant and adverse impact on the space programs of NASA's international partners. J.P.S.

N91-21980# Committee on Commerce, Science, and Transportation (U.S. Senate).
MISSION TO PLANET EARTH

In its NASA Authorizations 1990 p 121-221 (For primary document see N91-21977 13-84)
Avail: Subcommittee on Scoience, Technology, and Space, Senate, Washington, DC HC free; also available SOD HC $17.00 as 552-070-09349-4

Statements are presented by subcommittee members, and by management of Joint Oceanographic Institutions, Inc., the National Science Foundation's Office of Geosciences, the University Corporation of Atmospheric Research's Office of Interdisciplinary Earth Studies, and by the Associate Administrator of the Office of Space Flight of the National Aeronautics and Space Administration. Oral and written testimony, as well as submittals for the record, are included. Discussion centers on NASA's Mission to Planet Earth, which is a large segment of the U.S. Global Change Research Program, and the Mission's key components: the Earth Observing System; an information system to process, distribute, and further the understanding of the observations that are made; and the application of information gained to the earth's ecological problems. J.P.S.

N91-21981# Committee on Commerce, Science, and Transportation (U.S. Senate).
AERONAUTICS AND SPACE TECHNOLOGY
In its NASA Authorizations 1990 p 223-300 (For primary document see N91-21977 13-84)
Avail: Subcommittee on Scoience, Technology, and Space, Senate, Washington, DC HC free; also available SOD HC $17.00 as 552-070-09349-4

Statements are presented by subcommittee members and the National Aeronautics and Space Administration's Associate Administrator, Office of Aeronautics and Space Technology, with the focus on research and development critical to aviation, and to space technology and exploration. NASA's basic and applied research is seen as essential to the national security and to the economic well-being of the United States. Oral and written testimony, as well as submittals for the record, are included. Some of the specific topics discussed are: core research in areas such as aerothermodynamics, materials and structures, and information systems; the Civil Space Technology Initiative; the National Aero-Space Plane; the Exploration Technology Program; and in-space technology experiments. Also discussed are the effects of various kinds of propulsion on the environment, and problems of indiscriminate sharing of technological breakthroughs discovered at taxpayers' expense. Other statements that are included were made by university and corporate executives. J.P.S.

N91-21982# Committee on Commerce, Science, and Transportation (U.S. Senate).
SPACE SCIENCE AND APPLICATIONS
In its NASA Authorizations 1990 p 301-396 (For primary document see N91-21977 13-84)
Avail: Subcommittee on Scoience, Technology, and Space, Senate, Washington, DC HC free; also available SOD HC $17.00 as 552-070-09349-4

Hearings are presented on the National Aeronautics and Space Administration's budget request for fiscal year 1991, focusing on the space science and applications program. An opening statement by the Subcommittee Chairman and a statement by NASA's Associate Administrator are presented. All verbal and written testimony and submittals for the record are included. Specific research programs are outlined, such as technologies related to astrophysics, earth and life sciences, planetary exploration, materials processing, and communications. Witnesses from academia also testified, presenting the views of the National Academy of Science, the Association of American Universities, and the Universities Space Research Association. J.P.S.

N91-21983# Committee on Commerce, Science, and Transportation (U.S. Senate).
COMMERCIAL SPACE PROGRAMS
In its NASA Authorizations 1990 p 397-537 (For primary document see N91-21977 13-84)
Avail: Subcommittee on Scoience, Technology, and Space, Senate, Washington, DC HC free; also available SOD HC $17.00 as 552-070-09349-4

Presented are oral and written testimony and submittals for the record, of the National Aeronautics and Space Administration's programs and policies designed to attract private sector investment and involvement in space. NASA's Assistant Administrator of the Office of Commercial Programs describes the creation of 16 Centers for the Commercial Development of Space as a way that NASA has selected to achieve industrial interest in work or products derived from research in space. These Centers, consortia of 193 industries, 52 universities, and government, focus on specific areas of interest that could one day have commercial potential in high technology fields. The directors of the Centers make up a Management Council, which meets quarterly, to decide what needs to be done. As a measure of progress, it is noted that industrial contributions have increased from 20 to 70 percent, while government contributions have decreased from 80 to 30 percent since the Centers were started. Also presented are the oral and written testimony and submittals for the record on the budget for commercial space transportation from the Director of the Department of Transportation's Office of Commercial Space Transportation; and testimony on government's role in space commercialization from representatives of corporate management. J.P.S.

N91-21984# Regulatory Information Service Center, Washington, DC.
UNIFIED AGENDA OF FEDERAL REGULATIONS, OCTOBER 1990
Oct. 1990 1397 p Repr. from Federal Register of Monday, 29 Oct. 1990, v. 55, no. 209
(PB91-120527; RISC-90/43) Avail: NTIS HC/MF A99 CSCL 05D

Executive Order 12291 (Federal Regulation) and the Regulatory Flexibility Act (5 U.S.C. 602) require that agencies publish semiannual regulatory agendas describing regulatory actions they are developing. The Office of Management and Budget Memorandum dated 2 Jul. 1990, requires that each agency agenda include, at a minimum, certain specific types of information for each entry and that all agendas be published together in a Unified Agenda of Federal Regulations. The following parts in the issue of the Federal Register are the agency agendas, which together comprise the Oct. 1990 edition of the semi-annual Unified Agenda of Federal Regulations. GRA

85 URBAN TECHNOLOGY AND TRANSPORTATION

Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.

For related information see also *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

N91-21985# ICF Technology, Inc., Fairfax, VA.
TECHNOLOGY TRANSFER NEEDS ASSESSMENT, 1990
J. P. Town, M. B. Deardorff, and M. M. Kelly Apr. 1990 112 p (Contract EPA-68-01-7481)
(PB91-125674; EPA/540/8-90/007) Avail: NTIS HC/MF A06 CSCL 05A

The results of the Office of Solid Waste and Emergency Response (OSWER) Technology Transfer Needs Assessment of FY 1990 are summarized. The effort extends and updates a 1986 needs assessment conducted for the Superfund program and previous ORD (Office of Research and Development) studies on regional research and technology transfer needs. It compasses the Superfund (CERCLA), Hazardous Waste (RCRA), and Underground Storage Tank (UST) programs, including OSWER enforcement. Regional Environmental Service Divisions (ESDs) and Superfund Technical Support Project Forum members were also

included in the survey. The study attempts to explore actual and future needs, to the extent possible and further provides guidance for selecting technology transfer delivery methods, including electronic and other advanced media for information distribution, based on specific needs and audience characteristics. The results indicate the priority of technical needs across program areas and regions, and provide previously unavailable data regarding OSWER audiences. GRA

N91-21162# Norges Tekniske Hoegskole, Trondheim.
OFFSHORE TECHNOLOGY R AND D IN SPACE APPLICATIONS
Stewart D. W. Clark *In* Norwegian Space Center, From Earth to Space and Back: Selected Papers on Norwegian Space Activities Mar. 1990 p 13-18 (For primary document see N91-21159 13-12)
Avail: NTIS HC/MF A04

88 SPACE SCIENCES (GENERAL)

No abstracts in this category.

89 ASTRONOMY

Includes radio, gamma-ray, and infrared astronomy, and astrometry.

N91-21986# European Space Agency, Paris (France).
FROM GROUND-BASED TO SPACE-BORNE SUB-mm ASTRONOMY
B. Kaldeich, ed. Dec. 1990 384 p The 29th Liege International Astrophysical Colloquium held in Liege, Belgium, 3-5 Jul. 1990 (ESA-SP-314; ISBN-92-9092-098-X; ETN-91-98977) Copyright Avail: NTIS HC/MF A17; EPD, ESTEC, Noordwijk, Netherlands, HC 80 Dutch guilders

Aspects of past, present, and future submillimeter astronomy are discussed. Submillimetric cosmology, submillimeter observations of extragalactic objects, and millimeter observations of a complete sample of galaxies are studied. Different astronomical detection systems in submillimeter wavelengths are discussed. Star formation in the interstellar medium and interstellar chemistry are studied. Dust and direct detection instrumentation are reviewed. Ground based telescopes and submillimeter observation of the solar system are discussed. For individual titles, see N91-21987 through N91-22052.

N91-21987# National Air and Space Museum, Washington, DC. Lab. for Astrophysics.
SUBMILLIMETER OBSERVATIONS WITH THE KUIPER AIRBORNE OBSERVATORY
Martin Harwit *In* ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 21-24 (For primary document see N91-21986 13-89)
Copyright Avail: NTIS HC/MF A17; EPD, ESTEC, Noordwijk, Netherlands, HC 80 Dutch guilders CSCL 03A

Technical advances which have provided for increased sensitivity as well as progressively increasing spectral resolution in the Kuiper Airborne Observatory (KAO) are discussed. Far infrared and submillimeter observations at wavelengths from 0.1 to 1 mm reveal a variety of spectral lines arising from atomic and ionic fine structure transitions or rotational transitions of molecules. Advances in photometry, mapping capabilities and polarization analyses aboard KAO are summarized. Ways in which these new capacities have resulted in new astronomical insight are discussed. ESA

N91-21988*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
EARLY RESULTS FROM THE COSMIC BACKGROUND EXPLORER (COBE)
J. C. Mather, M. G. Hauser, C. L. Bennett, N. W. Boggess, E. S. Cheng, R. E. Eplee, Jr., H. T. Freudenreich, S. Gulkis (Jet Propulsion Lab., California Inst. of Tech., Pasadena.), R. B. Isaacman, and M. Janssen et al *In* ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 25-31 (For primary document see N91-21986 13-89)
Copyright Avail: NTIS HC/MF A17; EPD, ESTEC, Noordwijk, Netherlands, HC 80 Dutch guilders CSCL 03A

The Cosmic Background Explorer, launched 18 Nov. 1989, has nearly completed its first full mapping of the sky with all three of its instruments: A Far Infrared Absolute Spectrometer (FIRAS) covering 0.1 to 10 mm, a set of Differential Microwave Radiometers (DMR) operating at 3.3, 5.7, and 9.6 mm, and a diffuse Infrared Background Experiment (DIRBE) spanning 1 to 300 microns in ten bands. A preliminary map of the sky derived from DIRBE data is presented. Initial cosmological implications include: a limit on the comptonization parameter of 0.001, on the chemical potential parameter of 0.01, a strong limit on the existence of a hot smooth intergalactic medium, and a confirmation that the dipole anisotropy has the spectrum expected from a Doppler shift of a blackbody. There are no significant anisotropies in the microwave sky detected, other than from our own galaxy and a cos theta dipole anisotropy whose amplitude and direction agree with previous data. At shorter wavelengths, the sky spectrum and anisotropies are dominated by emission from local sources of emission within our Galaxy and Solar System. Preliminary comparison of IRAS (Infrared Astronomical Satellite) and DRIBE sky brightnesses toward the ecliptic poles shows the IRAS values to be significantly higher than found by DRIBE at 100 microns. The presence of gain and zero point errors in the IRAS total brightness data is suggested. The spacecraft, instrument designs, and data reduction methods are described. ESA

N91-21989# Ecole Normale Superieure, Paris (France).
EARLY COBE RESULTS AND SUPERCONDUCTING COSMIC STRINGS
M. Signore and N. Sanchez (Observatoire de Paris-Meudon, France) *In* ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 33-36 (For primary document see N91-21986 13-89)
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Constraints placed upon Superconducting Cosmic Strings (SCS) by preliminary results from the Cosmic Background Explorer (COBE) are reviewed. The cosmological evolution of SCS is placed under new constraints by millisecond pulsar timing measurements from COBE. The following constraints are obtained: the comptonization parameter due to SCS less than or equal to 0.001; the chemical potential due to SCS is less than or equal to 0.0005; the electromagnetic to gravitational radiation ratio of SCS is less than or equal to 0.023; on the string parameter GMu less than or equal to 0.000001 for generic values of string evolution parameters, GMu is less than or equal to 10(exp -7) when tacking into account numerical simulation results. The latests PSR1937+21 timing measurements and the early COBE results converge to the same upper limits on Gmu; the limits continue to descend but the breaking point is not yet reached. ESA

N91-21990# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Astrophysics Div.
FIRST: FAR INFRARED AND SUBMILLIMETER SPACE TELESCOPE
Urban Frisk *In its* From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 37-45 Previously announced as N91-18925 (For primary document see N91-21986 13-89)
Copyright Avail: NTIS HC/MF A17; EPD, ESTEC, Noordwijk, Netherlands, HC 80 Dutch guilders

The Far Infra-Red and Submillimeter Space Telescope (FIRST),

an element of the ESA long term science program, is described. It is foreseen as a large diameter (4.5 to 8 m) passively cooled telescope, equipped with a combination of photometer/camera and very high resolution spectrometers. The spectrometers will utilize direct detection and heterodyne techniques over the band wavelengths of 85 to 600 microns. The photometers will consist of bolometers and photoconductor array detectors. FIRST is foreseen to be launched shortly after the year 2000. ESA

N91-21991# Rome Univ. (Italy). Dipt. di Fisica.
SUB-MILLIMETRIC COSMOLOGY: FROM GROUND BASED TO SPACE OBSERVATIONS
Paolo deBernardis, Silvia Masi, B. Melchiorri (Consiglio Nazionale delle Ricerche, Rome, Italy), and Francesco Melchiorri *In* ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 49-58 (For primary document see N91-21986 13-89)
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The contribution of submillimetric observational techniques to cosmology is reviewed. Particular attention is devoted to the analysis of optimized experiments at ground based telescopes for balloon-borne instruments and spaceborne observatories. The possible space programs developed to follow the Cosmic Background Explorer (COBE) mission are reviewed. A medium size telescope dedicated to the study of Cosmic Background Radiation (CBR) anisotropies at angular scales smaller than 5 degrees is called for. ESA

N91-21992# University Coll., Cardiff (Wales). School of Mathematics.
THE MICROWAVE BACKGROUND: ITS SMOOTHNESS AND FREQUENCY DISTRIBUTION AS AN ASTROPHYSICAL PRODUCT **c90**
Fred Hoyle, N. C. Wickramasinghe, and Geoffrey Burbidge (California Univ., San Diego, La Jolla.) *In* ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 59-63 (For primary document see N91-21986 13-89)
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The use of astrophysical sources in providing an understanding of the total energy density of the background is reviewed. The need of a thermalizing agent is stressed. The nearer such an agent comes to establishing thermodynamic equilibrium, the smoother the background becomes. This is shown to be true despite irregularities in the distribution of the thermalizer. The ejection of iron whiskers from galaxies and the ways in which such whiskers could affect the microwave background are discussed. ESA

N91-21993# Academy of Sciences (USSR), Moscow. Space Research Inst.
SUBMILLIMETER ASTRONOMY AND COSMOLOGICAL TESTS
G. B. Sholomitskii *In* ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 65-69 (For primary document see N91-21986 13-89)
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Two observational techniques in submillimeter wavelengths are discussed with the goal of independent omega(sub zero) and omega(sub igg) (intergalactic gas) determination. The aim was to show how millimeter and submillimeter wave 1 m class cooled telescopes such as AELITA can proceed with anisotropy studies to less than or equal to 1 degree angular scales, as well as contribute to proving the flatness of the universe. ESA

N91-21994# Hawaii Univ., Honolulu. Inst. for Astronomy.
SUBMILLIMETER OBSERVATIONS OF EXTRAGALACTIC OBJECTS IN THE WAVELENGTH RANGE 50 MICRONS TO 1 MM
David B. Sanders *In* ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 71-78 (For primary document see N91-21986 13-89)
Copyright Avail: NTIS HC/MF A17; EPD, ESTEC, Noordwijk, Netherlands, HC 80 Dutch guilders

Ground based and space based observations of galaxies is the 50 micron to 1 mm continuum band are used to identify a wide range of objects. Normal and active galaxies, radio quiet and radio loud quasars and blazars are observed. Millimeter and submillimeter wave observations of molecular lines, principally from the CO molecule show the dominant component of the interstellar medium in many galaxies and some quasars to be molecular H2 rather than atomic H I Gas. Submillimeter spectroscopy is sugggested as the dominant method for probing the gas content of galaxies. ESA

N91-21995# Osservatorio Astronomico, Padova (Italy).
EXTRAGALACTIC SOURCE COUNTS, CONFUSION LIMITS AND CONTRIBUTIONS TO THE BACKGROUND RADIATION IN THE SUB-mm **c93**
Alberto Franceschini, L. Danese, G. DeZotti, P. Mazzei, and L. Toffolatti (Padua Univ., Italy) *In* ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 79-84 (For primary document see N91-21986 13-89)
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Possible outcomes of surveys for extragalactic sources to be carried out by the next generation of ground based and satellite borne telescopes in the far infrared and sub-mm wavelengths are discussed. The confusion limits for several wavebands are computed. Surveys at wavelengths greater than 100 microns (i.e., beyond the dust emission peak) would allow detection of dust radiation from distant and primeval galaxies. The evolution of the metal content of galaxies could thus be investigated. The role of Cosmic Background Explorer (COBE) data in providing important constraints is discussed. ESA

N91-21996*# California Univ., Berkeley. Dept. of Physics.
THE (C II) 158 MICRON LINE MAPPING OF SPIRAL GALAXIES
Gordon J. Stacey, N. Geis, Reinhard Genzel, J. M. Jackson, Albrecht Poglitsch (Max-Planck-Inst. fuer Physik und Astrophysik, Garching, Germany, F.R.), and Charles H. Townes *In* ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 85-91 (For primary document see N91-21986 13-89) (Grant NAG2-208)
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Large scale maps of the face of spiral galaxies M51, M83, and NGC 6946 in the 158 micron (C II) fine structure line. The maps are obtained from the Far-infrared Imaging Fabry-Perot Interferometer (FIFI) during its first series of flights on board the Kuiper Airborne Observatory. The (C II) line emission is ubiquitous and easily traced over the mapped regions of each of the galaxies. The (C II) maps are compared with those obtained with similar sized beams in the CO line. The data available from these maps is interpreted. ESA

N91-21997# Tokyo Univ., Sagamihara (Japan). Inst. of Space and Astronautical Science.
JAPANESE SPACE PROGRAMMES OF IR AND SUB-mm ASTRONOMY
Haruyuki Okuda *In* ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 93-98 (For primary document see N91-21986 13-89)
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The history of infrared astronomy in Japan using balloons and rockets is summarized. Observations of diffuse emission, galactic radiation and cosmic background radiation have to date been the main areas of interest in Japanese infrared astronomy. C II line mapping of the galactic plane, a new area of interest, is discussed. A satellite borne mission intended to further such line mapping research is described. The mission is Infra Red Telescope in Space (IRTS) and consists of a small cryogenically cooled telescope

specifically designed for observations of diffuse IR and sub-mm radiation. ESA

N91-21998# Academy of Sciences (USSR), Moscow. Inst. of Space Research.

RELICT 2 PROJECT: SCIENTIFIC PROGRAM AND STRUCTURE **c90**

Igor Strukov, D. Skulachev, N. Budilovich, Yu. Nemlikher, V. Korogod, A. Kosov, A. Rukavicin, V. Aniskovich, and R. Borovski *In* ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 99-104 (For primary document see N91-21986 13-89)

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The advantages of satellite-borne experiments over ground based and balloon experiments for studying large scale anisotropy are reviewed. The objectives of the RELICT 2 mission, are described. The mission is designed to measure the large scale anisotropy and the spectrum of the 2.7 K cosmic background. Preliminary results of RELICT 2 complex testing are presented. At 34 GHz a sensitivity of 3 mK/square root of the Hz is received at 77 K. Other radiometer schemes are considered. Methods of improving radiometer sensitives are discussed. ESA

N91-21999# European Southern Observatory, Garching (Germany, F.R.).

MILLIMETER OBSERVATIONS OF A COMPLETE SAMPLE OF GALAXIES: IMPLICATIONS FOR GAS MASS AND COLD DUST COMPONENT

P. Andreani, Alberto Franceschini, and J. Roland (Institut d'Astrophysique, Paris, France) *In* ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 105-109 Sponsored by CNR (For primary document see N91-21986 13-89)

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Results of observations of the continuum flux at lambda equal to 1.2 mm of a normal galaxy sample selected from the IRAS (Infrared Astronomy Satellite) point source catalog are reviewed. Nine galaxies out of twelve observed with the IRAM 30 m telescope are detected at better than 3 sigma. The mm fluxes, together with IRAS 100 micron data, are consistent with a dust temperature of approximately 20 K and a dust opacity spectral index of approximately 2. Masses of dust and gas are estimated from these observations following various models of interstellar dust emission. ESA

N91-22000# Lancaster Univ. (England). Dept. of Physics and Astronomy.

THE IMPORTANCE OF SUBMILLIMETRE OBSERVATIONS OF RADIO QUIET AND RADIO LOUD AGN'S **c90**

Ian Robson, David Hughes, and Walter K. Gear (Royal Observatory, Edinburgh, Scotland) *In* ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 11-115 (For primary document see N91-21986 13-89)

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Galaxies such as NGC253 and M82 which radiate strongly in the far infrared are studied. They produce a typical thermal emission also seen in a wide range of galaxies which is considered to be a sign of extensive star formation. The use of submillimeter observations to differentiate between thermal or nonthermal synchrotron emission in radio quiet quasars and Seyfert 1 galaxies is discussed. Radio loud active galaxies such as blazars, have non-thermal spectra which become optically thin at about 1 mm. Monitoring this emission is shown to be a crucial test of the emission mechanisms of the relativistic jets believed to power blazars. ESA

N91-22001*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

THE CONFUSION LIMITS TO THE SENSITIVITY OF SUBMILLIMETER TELESCOPES

George Helou and Charles A. Beichman (Institute for Advanced Study, Princeton, NJ.) *In* ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 117-123 (For primary document see N91-21986 13-89)

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The two major sources of confusion that limit the sensitivity of continuum observations at submillimeter wavelengths outside the galactic plane are discussed. One of the sources is the spatial structure of the thermal emission from dust in the Milky Way. The crowding of extragalactic sources at faint levels is the second source of confusion. Estimates of the noise expected from these two types of confusion as a function of wavelength and beam size on the sky are presented and compared to detector and photon noise estimates for proposed spaceborne telescopes. ESA

N91-22002# Max-Planck-Inst. fuer Physik und Astrophysik, Garching (Germany, F.R.). Inst. fuer Extraterrestrische Physik.

THE GALACTIC CENTER AT SUBMILLIMETER AND FAR-INFRARED WAVELENGTHS Progress Report

Reinhard Genzel *In* ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 127-134 Previously announced as N91-16978 (For primary document see N91-21986 13-89)

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Progress in 10 micron and 1 mm observations of the central 100 pct. of our galaxy and their interpretation is discussed. Emphasis is placed on the physical conditions and dynamics in the nucleus derived from spectroscopic and broadband observations of interstellar gas and dust. The observations suggest that sporadic mass inflow into the central parsec from systems of large, massive molecular clouds dominates the dynamics of the interstellar gas at the Galactic Center. Outflow fits most of the velocity measurements but is much less acceptable than inflow in the overall physical picture now developing. ESA

N91-22003*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

SOFIA: THE STRATOSPHERIC OBSERVATORY FOR INFRARED ASTRONOMY

Roger H. Hildebrand (Chicago Univ., IL.) and Jacqueline A. Davidson *In* ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 135-139 (For primary document see N91-21986 13-89)

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SOFIA, an airborne observatory intended to be carried aboard a Boeing 747 high performance aircraft, is described. The observatory is predicted to provide a threefold greater aperture than that of the Kuiper telescope. The Boeing aircraft will carry the 2.5 diameter telescope and its observers to altitudes of 14,000 and above where the atmosphere is very nearly transparent at all wavelengths. Various aspects and specific missions of the SOFIA project, a cooperative venture of the U.S. and Germany, are described. ESA

N91-22004# Tokyo Univ., Sagamihara (Japan). Inst. of Space and Astronautical Science.

LARGE-SCALE (CII) 158 MICRON EMISSION OF THE GALAXY OBSERVED BY A BALLOON-BORNE TELESCOPE **c93**

Hiroshi Shibai, Haruyuki Okuda, T. Nakagawa, H. Matsuhara, T. Maihara, K. Mizutani, Y. Kobayashi, N. Hiromoto, T. Nishimura, and F. J. Low (Arizona Univ., Tucson.) *In* ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 141-147 (For primary document see N91-21986 13-89)

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Strong (CII) emission lines at 158 microns are detected along the galactic plane using a balloon borne infrared telescope equipped with a liquid helium cooled Fabry-Perot spectrometer. The (CII) intensity distribution is quite similar to that of CO12 and also ressembles those of FIR and 5 GHz continuum but is

completely different from that of HI 21 cm. The diffuse (CII) emission probably comes from the diffuse regions illuminated by the general interstellar UV radiation field and form as mantles of giant molecular clouds. If most (CII) intensity observed comes from the diffuse C+ regions, the mass the C+ regions is estimated to be more than 410 pct. of that of the molecular gas traced by CO. The total energy of the (CII) line emitted from the inner Galactic disk amounts to 2.8 x 10(exp 7) L sub galactic mass, or about 0.36 pct. of the total FIR luminosity of the same region. ESA

N91-22005# Max-Planck-Inst. fuer Physik und Astrophysik, Garching (Germany, F.R.).
THE MPE/UCB FAR-INFRARED IMAGING FABRY-PEROT INTERFEROMETER (FIFI)
Albrecht Poglitsch, J. W. Beeman, N. Geis, Reinhard Genzel, M. Haggerty, E. E. Haller, J. M. Jackson, M. Rumitz, Gordon J. Stacey, and Charles H. Townes (California Univ., Berkeley.) *In* ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 149-152 (For primary document see N91-21986 13-89)
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FIFI, an imaging spectrometer with two or three Fabry-Perot Interferometers (FPI) in series for airborne astronomical observations in the far infrared range (lambda = 40 to 200 microns) is described. It employs 5 by 5 arrays of photoconducting detectors and offers spectral resolutions as small as 2 km/s. Resolution and bandwidth can be set over a wide range to match a variety of astronomical sources. Cryogenic optics minimizes thermal background radiation and provides for inflight step tunable spatial resolution. At 158 microns wavelength the background limited NEP is 3 x 10(exp -15) W/Hz at 40 km/s resolution and with two FPI's; with three FPI's the expected NEP is less than or = 10(exp -15) W/Hz km/s resolution. The frequency shopping mode allows for line detection in extended objects. Absolute internal flux calibration ensures adequate flat fielding of the array elements. ESA

N91-22006# Amsterdam Univ. (Netherlands). Inst. of Astronomy.
LATE-TYPE STARS AT FAR-INFRARED AND SUB-MILLIMETER WAVELENGTHS Abstract Only
Teije deJong *In* ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 153 (For primary document see N91-21986 13-89)
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The evolution of Asymptotic Giant Branch (AGB) stars is analyzed through analysis of far infrared submillimeter radiation. The AGB phase occurs at the end of the life of an intermediate mass (1 to 8 solar masses) star just before it turns into a planetary nebula. AGB stars generate energy in hydrogen and helium burning shells in the stellar envelope just outside a degenerate carbon-oxygen core of about 0.6 solar masses. Measurements of the spectral lines of various molecules and of the continuing radiation of dust are used to provide more information on the chemical composition, the molecular abundances and the formation of dust particles in circumstellar shells. ESA

N91-22007# Max-Planck-Inst. fuer Radioastronomie, Bonn (Germany, F.R.).
THE 1.3 mm CONTINUUM EMISSION FROM CIRCUMSTELLAR ENVELOPES **c93**
Charles Malcolm Walmsley, R. Chini, Ernst Kreysa, H. Steppe, P. Andre, Thierry Forveille, and A. Omont (Centre d'Etudes et de Recherche de la Machine-Outil, Saint-Martin-d'Heres, France) *In* ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 155-157 (For primary document see N91-21986 13-89)
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Results of a survey carried out on the 1.3 mm continuum emission, from the circumstellar envelopes of late type stars are presented. Some 26 out of 38 stars are detected including several Mira variables and OH-IR stars. It is concluded that the emission from the optically visible Mira variables and semiregulars is photospheric in origin. ESA

N91-22008# European Southern Observatory, La Silla (Chile).
THE SWEDISH-ESO SUBMILLIMETER TELESCOPE (SEST)
Lars-Ake Nyman and R. S. Booth (Onsala Space Observatory, Sweden) *In* ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 159-160 (For primary document see N91-21986 13-89)
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SEST, a 15 m submillimeter telescope situated on La Silla in Chile is described. For its first two years of operation it has worked mainly at mm wavelengths. After adjustments, the telescope is capable of observations up to 500 GHz. An SIS (superconducting tunnel junction) receiver working at 350 GHz to be installed before the winter of 1991 is described. This receiver will allow regular submillimeter observations to be carried out. Being the first large mm/submillimeter telescope placed in the Southern Hemisphere, SEST is in a unique position to study the Magellanic clouds. ESA

N91-22009# Harvard-Smithsonian Center for Astrophysics, Cambridge, MA.
THE SMITHSONIAN ASTROPHYSICAL OBSERVATORY SUBMILLIMETER WAVE TELESCOPE ARRAY
Colin Masson *In* ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 161-164 (For primary document see N91-21986 13-89)
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A submillimeter wavelength interferometer array built by the Smith Astrophysical Observatory is described. The telescope is to be located at a high mountain site and will operate in the major atmospheric windows from 200 to 900 GHz. The array is to consist of six antennas, each 6 m in diameter. All antennas are to be movable over a Y shaped track with maximum baselines of several hundred meters. The facility is designed to operate simultaneously at two different frequencies, and is equipped with a versatile digital spectrometer permitting measurements of many different lines at once. ESA

N91-22010# Max-Planck-Inst. fuer Physik und Astrophysik, Garching (Germany, F.R.).
COHERENT AND INCOHERENT DETECTION **c93**
Andrew I. Harris *In* ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 165-169 (For primary document see N91-21986 13-89)
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The choice of coherent or incoherent detection for a given application at submillimeter and far infrared wavelengths is discussed. Both methods are comparable in sensitivity and technological feasibility over this spectral range. No one type of detection of filtering is superior for all applications at these wavelengths. Detailed tradeoffs in terms of resolution and detector availability are considered in determining whether Fourier transform, grating, Fabry-Perot, or heterodyne instruments will be best suited to a given task. ESA

N91-22011# Ecole Normale Superieure, Paris (France).
THE STUCTURE OF MOLECULAR CLOUDS: NEW QUESTIONS **c90**
Edith Falgarone *In* ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 173-178 (For primary document see N91-21986 13-89)
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Observational results of molecular clouds not closely associated with massive star formation are studied. Observations which point towards a morphology and a type of dynamical evolution much

more complex than previously thought are given particular attention. The apparent self similarity of the medium, its fractal distribution, the lack of any characteristic scale above 0.02 pct. the connectedness of the cold dense gas and the close interconnection between the different phase within molecular clouds are discussed. The various interpretations given to the existence of broad wings in the millimeter line profiles in regions not associated with stellar outflows are summarized. ESA

N91-22012*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
SUBMILLIMETER ASTRONOMY AND LOW MASS STAR FORMATION
Charles A. Beichman (Institute for Advanced Study, Princeton, NJ.) *In* ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 179-187 (For primary document see N91-21986 13-89)
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Surveys made at wavelengths shorter than 100 microns are criticized in that they are biased against finding the coldest, most deeply obscured, and possibly youngest protostars. Large scale mapping of star forming regions in the submillimeter continuum and in lines such as CS H2CO and NH3, that are excited at high density, is identified as crucial in order to find clouds in the earliest stages of collapse into stars. The use of photometry from 1 to 1000 microns in characterizing the disks around embedded stars and T Tauri stars is outlined. ESA

N91-22013# Max-Planck-Inst. fuer Radioastronomie, Bonn (Germany, F.R.).
INVESTIGATION OF HIGHLY EXCITED CO TRANSITIONS IN OMC-1
Gerhard W. Schwaab, Hans Peter Roeser, Johannes Schmid-Burgk, and Ruth U. Titz *In* ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 189-191 (For primary document see N91-21986 13-89)
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High-J CO observations performed from aboard the KAO (Kuiper Airborne Observatory) in Sep. 1988 and Feb./Mar. 1989 are reported. The first high resolution detections of CO (J = 9 to 8) at 289 microns, CO (J = 11-10) at 237 microns, CO (J = 12-11) at 217 microns and CO (J = 14-13) at 186 microns were made and the OMC 1 (Orion Molecular Cloud 1) was studied over several arcmin around BN-KL. The flux distribution in the high J transitions roughly follows the distribution as it is known from CO (J = 7-6) observations. The most prominent position is BN-KL. However, total fluxes of more than 100 K.km/sec are found up to three arcmin distance in CO (J = 14-13). The lines show widths of 4 to 5 km/sec along the molecular ridge. Narrow lines with widths of 2 to 3 km/sec were found in positions north east of BN-KL and the ionization bar. ESA

N91-22014# Max-Planck-Inst. fuer Radioastronomie, Bonn (Germany, F.R.).
A HIGHLY COLLIMATED BIPOLAR OUTFLOW IN THE CORE OF OMC-1: CO SUBMILLIMETER EMISSION **c90**
Johannes Schmid-Burgk, Hans Peter Roeser, Gerhard W. Schwaab, and Ruth U. Titz *In* ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 193-195 (For primary document see N91-21986 13-89)
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A CO 7-6 survey of Orion Molecular Cloud (OMC)-1 reveals line wings, indicative of molecular outflow, at a position approximately two degrees south of the plateau/hot core source. A large bipolar flow system was found that displays the possibility that the lobe of blueshifted velocities protrude into the core of the H II region M42. Such a configuration permits studies of photodissociative interactions that develop and increase as the molecular jet approaches the ionized region. Large beam observations of the outflow region in higher CO transitions indicate the existence of line wings that might be the result of such interactions. ESA

N91-22015# California Univ., Berkeley. Dept. of Physics.
REQUIREMENTS FOR SIS RECEIVERS IN THE 500-1000 GHz REGION
E. C. Sutton *In* ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 199-204 (For primary document see N91-21986 13-89)
(Grant NSF AST-88-18327)
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Superconductor insulator superconductor (SIS) tunnel junction mixers which are highly promising as receivers with near quantum limited performance for space applications in the 500 to 1000 GHz range are discussed. Their success at these high frequencies depends on being able to make tunnel junctions with large superconducting energy gaps, low subgap leakage, and low capacitance. These in turn imply junctions with small areas, made of refractory materials, and with high current densities. The leading candidates which meet these criteria are listed and reviewed. ESA

N91-22016# California Univ., Berkeley. Space Sciences Lab.
FAR-INFRARED HETERODYNE TECHNOLOGY
Albert L. Betz and R. T. Boreiko *In* ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 205-210 (For primary document see N91-21986 13-89)
(Grants NAG2-254; CS-10-88)
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The applications of heterodyne technology in extending high resolution spectroscopy to the short submillimeter and far infrared spectral regions are discussed. The use of spectrometers with far infrared lasers as local oscillators and Schottky diodes as mixers in astronomy is discussed. Improvements in diode parameters and laser utility are predicted, making this technology preeminent in the far infrared for years to come as far as airborne spectrometers are concerned. For ground based spectrometers increased competition is expected from superconductor insulator superconductor (SIS) tunnel junction technology at frequencies below 1000 GHz. ESA

N91-22017*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
DEVELOPMENT OF COMPONENTS FOR SUBMILLIMETER WAVE HETERODYNE RADIOMETERS AT JPL
Margaret A. Frerking, B. D. Hunt, H. G. LeDuc, W. R. McGrath, P. H. Siegel, and T. Tolmunen *In* ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 211-214 (For primary document see N91-21986 13-89)
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Components for the key elements of submillimeter wave heterodyne receivers are described. The devices and components are inherently space qualifiable having low power and mass needs and exhibiting robustness. Nb and NbN superconductor insulator superconductor (SIS) tunnel junctions are selected for the nonlinear mixing element because of their robustness. NbN exhibits a large superconducting bandgap, allowing operation in excess of 1500 GHz. Both waveguide mounts, for the lower frequencies and planar antenna mixer mounts for the higher frequency range, are used. Quasi-optical components are used for frequency multiplexing and combining. ESA

N91-22018# Bell Telephone Labs., Inc., Holmdel, NJ.
LDR: A SUBMILLIMETER GREAT OBSERVATORY
Robert Wilson *In* ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 215-219 (For primary document see N91-21986 13-89)
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The Large Deployable Reflector (LDR), a high Earth orbit free flying 10 to 20 m diameter deployable telescope, is described. The LDR is intended for use throughout the submillimeter band, using imaging receivers with unprecedented sensitivity and angular resolution. Its mission is to produce pictures of line emission regions in the solar neighborhood, in nearby galaxies and in objects at the edge of the known galaxy distribution. It is predicted to be an ideal instrument for exploring the first galaxies and protogalaxies as the submillimeter cooling lines should light up as soon as metals form. ESA

N91-22019# California Inst. of Tech., Pasadena.
A SUBMILLIMETER MISSION FOR THE 1990S: SMMM
Thomas G. Phillips *In* ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 221-228 (For primary document see N91-21986 13-89)
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The detailed design and science rationale for the Explorer or submillimeter moderate mission (SMMM) is presented. Equipped with a 4 m class telescope, the SMMM mission follows the Explorer submillimeter wave astronomy satellite (SWAS) mission, equipped with a 55 cm diameter telescope, and precedes the Large Deployable Reflector (LDR) mission with a 210 m telescope. The submillimeter spectroscopy and far infrared continuum studies of all these missions are carried out using ambient temperature telescopes. The instrumentation of SMMM is cooled to liquid helium temperatures and includes a high resolution spectrometer using superconductor insulator superconductor (SIS) receivers for the 300 to 600 micrometer band. A Fabry-Perot spectrometer with an array of bolometer detectors is used for the 100 to 300 micrometer band and an array of bolometers is used for continuum studies in the 100 to 800 micrometer band. ESA

N91-22020# Observatoire de Paris-Meudon (France).
PRONAOS
Pierre Encrenaz *In* ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 229-230 (For primary document see N91-21986 13-89)
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Th PRONAOS (French acronym for national project for submillimeter observation) mission is described. The mission involves a 2 m class telescope flown on a gondola under a 900,000 cubic meter balloon from Sicily and Spain for a 22 to 26 hour flight. The segmented mirrors of the telescope can be adjusted in flight by 18 actuators permitting corrections due to temperature changes during the balloon flight. The receiver consists of 4 bolometers cooled to 0.3 K designed to observe dust emissivity properties in our galaxy and measure the Sunyaev-Seldovich effect. ESA

N91-22021# Manchester Univ. (England). Dept. of Mathematics.
INTERSTELLAR CHEMISTRY AND SUBMILLIMETRE ASTRONOMY
Tom J. Millar *In* ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 233-238 (For primary document see N91-21986 13-89)
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Astronomical models of diverse astronomical regions are reviewed. Star forming clouds, photodissociation regions, protostellar winds and shocked gas are considered. The oxygen budget in interstellar clouds and metal hybride formation are studied. The chemistries of particular elements in interstellar regions are commented upon. Astronomical models particularly relevant to present and future submillimeter observations are given particular attention. The need to better understand surface chemistry in determining molecular synthesis in certain regions is stressed. ESA

N91-22022# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
FIRST DETECTION OF C3H2 AT SUB-mm WAVELENGTHS
Astrid Heske, M. JourdaindeMuizon, and L. B. dHendecourt (Paris Univ., France) *In its* From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 239-241 (For primary document see N91-21986 13-89)
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Study of C3H2 emission towards sub mm transitions is described. C3H2 emission is sought for in a small number of objects selected for their strong three micron emission features. The emission values obtained are used to check the calculated transition frequencies in astronomical objects. First detection of C3H2 at sub mm wavelengths towards the compact planetary nebula IRAS 21282 + 5050 is reported. The emission profile indicates that the CH line, similar the CO line, originates in the expanding circumstellar envelope. ESA

N91-22023# Harvard-Smithsonian Center for Astrophysics, Cambridge, MA.
SUBMILLIMETER WATER MASERS AT 321 AND 325 GHz **c36**
Karl M. Menten, Gary J. Melnick, and Thomas G. Phillips (California Inst. of Tech., Pasadena.) *In* ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 243-247 (For primary document see N91-21986 13-89)
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Astronomical observations of the (10 sub 29) to (9 sub 36) and (5 sub 15) to (4 sub 22) transitions of water vapor at frequencies near 321 and 325 GHz respectively are reported. Using the Caltech Submillimeter Observatory the (10 sub 29) to (9 sub 36) line is detected toward six star forming regions and eleven late type stars. The (5 sub 15) to (4 sub 22) line is detected toward four star forming regions. In all cases, most likely maser action is observed. Toward some sources a complicated spectrum with high velocity emission features is observed in the 325 GHz transition. Emission in the high excitation 321 GHz line is mostly found at velocities near the systematic velocities of the regions studied. ESA

N91-22024# California Univ., Berkeley.
EXCITATION OF SUBMILLIMETER WATER MASERS Abstract Only **c36**
David A. Neufeld and Gary J. Melnick (Harvard-Smithsonian Center for Astrophysics, Cambridge, MA.) *In* ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 249 (For primary document see N91-21986 13-89)
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The excitation of maser emission in submillimeter transitions of interstellar and circumstellar water is considered. Using an escape probability method, the equilibrium populations in 349 rotational states of both ortho- and para-water under varying conditions of gas temperature, density, water abundance, and radiation field are determined. The results show that under suitable conditions, collisional excitation of warm (1000 K) interstellar gas may result in significant maser action in a total of 22 centimeter, millimeter, and submillimeter transitions of H2O. ESA

N91-22025# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
THE SUBMILLIMETER WAVE ASTRONOMY SATELLITE **c18**
Gary J. Melnick, A. Dalgarno, N. R. Erickson, G. G. Fazio, P. F. Goldsmith, Martin Harwit, D. J. Hollenbach, D. G. Koch, David A. Neufeld, and R. Schieder (Cologne Univ., Germany, F.R.) et al *In* ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 251-256 (For primary document see N91-21986 13-89)
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The Submillimeter Wave Astronomy Satellite (SWAS) selected for flight as part of the Small Explorer Program is described. SWAS consists of a 55 by 71 cm near optical quality off axis primary mirror, two heteorodyne radiometers with Schottky barrier diode mixers, and a single broadband (1.4 GHz) Acousto Optical Spectrometer (AOS). SWAS primary objective is to conduct a high spectral resolution survey of galactic molecular clouds in low lying transitions of water, molecular oxygen, atomic carbon and isotopic carbon monoxide. These species are crucial in gaining a better understanding of the chemistry and cooling of dense molecular clouds. ESA

N91-22026# Space Research Organization Netherlands, Groningen. Lab. for Space Research.
FIR AND SUB-mm DIRECT DETECTION SPECTROMETERS FOR SPACEBORNE ASTRONOMY
Jan J. Wijnbergen and Thijs deGraauw *In* ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 259-263 (For primary document see N91-21986 13-89)
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Candidate spaceborne sub-mm instrumentation proposed for space projects with large passively cooled telescopes are reviewed. Grating instruments and Fourier transform spectroscopy (FTS) spectrometers are discussed. Particular attention is given to imaging Fabry-Perot spectrometers. The special needs of the Large Deployable Reflector (LDR) and for the Far InfraRed Space Telescope (FIRST) missions in this area are outlined. Possible Fabry-Perot spectrometer setups are diagrammed and outlined. The use of spherical and multiplex Fabry-Perot spectrometers is discussed. ESA

N91-22027# Max-Planck-Inst. fuer Radioastronomie, Bonn (Germany, F.R.).
SUB-mm DIRECT PHOTOMETRY WITH LARGE TELESCOPES
Ernst Kreysa *In* ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 265-270 (For primary document see N91-21986 13-89)
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Bolometer systems used on large sub mm telescopes for carrying out sensitive continuum measurements are described. The MPIFR bolometer system on the IRAM 30 m MRT and the SEST (Swedish-ESO Submillimetre Telescope) telescope is given special attention. The characteristics of the bolometer are presented as that of representative example. Special observation procedures designed to account for variations in the limit surface of large telescopes due to gravity, temperature and wind are summarized. Performance figures and plans for future instrumentation are outlined. ESA

N91-22028# Centre National de la Recherche Scientifique, Orsay (France). Inst. d'Astrophysique Spatiale.
SUBMILLIMETER OBSERVATIONS OF INTERSTELLAR DUST
Jean-Loup Puget and F. Boulanger *In* ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 271-274 (For primary document see N91-21986 13-89)
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Ways of using thermal dust emission as a measure of the dust mass along the line of sight are outlined. Measurements at long wavelengths, well beyond the peak of the emission, in the Rayleigh-Jeans part of the spectrum are recommended in order to drive a gas column density based on the gas to dust ratio. At these wavelengths, the measured intensity is proportional to the dust temperature and the optical depth. The optical depth is proportional to the total amount of material. The optical depth depends on the optical properties of the dust at these long wavelengths but not on the grain size distribution. ESA

N91-22029# Leiden Univ. (Netherlands).
THE 0 DEG (63 MICRON) LINE EMISSION FROM GALACTIC HIGH LATITUDE CIRRUS CLOUDS **c93**
Ronald Stark *In* ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 275-278 (For primary document see N91-21986 13-89)
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The IRAS 60 and 100 micrometer flux from cirrus clouds is commonly explained by dust continuum emission. This explanation is criticized as it requires unexpectedly high dust temperatures in some cases. It is argued that the contribution of fine stucture emission of neutral oxygen (63 microns), can be significant in the IRAS (Infrared Astronomy Satellite) 60 micron band. The neutral oxygen line emission together with the dust continuum emission offers a plausible explanation of the observed flux ratio as well as of its variation across individual clouds. ESA

N91-22030# Max-Planck-Inst. fuer Radioastronomie, Bonn (Germany, F.R.).
THE SEARCH FOR PROTOSTARS IN HIGH MASS STAR FORMING REGIONS
Thomas L. Wilson *In* ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 279-285 (For primary document see N91-21986 13-89)
Copyright Avail: NTIS HC/MF A17; EPD, ESTEC, Noordwijk, Netherlands, HC 80 Dutch guilders

An identification method and search strategy for finding the locations of protostars is presented. No protostars fitting the strict definition of a protostar have been found. The definition reads as follows: 'an isolated interstellar cloud undergoing inexorable gravitational contraction to form a single star'. It is suggested that not all stars are formed coevally and that protostars should occur in regions where massive stars have already formed. The general sites where protostars are located should thus be known. ESA

N91-22031# Cambridge Univ. (England). Cavendish Lab.
THE JAMES CLERK MAXWELL TELESCOPE Status Report Abstract Only
Richard Hills *In* ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 289 (For primary document see N91-21986 13-89)
Copyright Avail: NTIS HC/MF A17; EPD, ESTEC, Noordwijk, Netherlands, HC 80 Dutch guilders

The status report of the James Clerk Maxwell Telescope (JCMT) after its third year of operation is presented. The site on Mauna Kea (Hawaii) does indeed offer conditions for observations at frequencies above 400 GHz for something like 30 percent of the time. The wind, storm and sun protection properties of the enclosure and membrane are reviewed. Pointing accuracy and errors produced by thermal effects are reviewed. An overall surface accuracy of 325 microns rms is found for millimeter wave signals using a 'phase-recovery' technique. ESA

N91-22032# California Inst. of Tech., Pasadena.
THE CALTECH SUBMILLIMETER OBSERVATORY Abstract Only
Thomas G. Phillips *In* ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 291 (For primary document see N91-21986 13-89)
Copyright Avail: NTIS HC/MF A17; EPD, ESTEC, Noordwijk, Netherlands, HC 80 Dutch guilders

The Caltech Submillimeter Observatory (CSO), which completed its first full year of observations in 1989, is described. Consisting of the Leighton 10.4 m diameter telescope located on Mauna Kea (Hawaii) at an alitiude of 4,100 m, the telescope is designed to achieve diffraction limited operation at 3220 micrometers. Continued adjustments to the surface are expected to increase surface accuracy from 27 to 17 microns (rms). ESA

N91-22033# Max-Planck-Inst. fuer Radioastronomie, Bonn (Germany, F.R.).
THE SUBMILLIMETER TELESCOPE (SMT)
Jacob W. M. Baars and Robert M. Martin (Arizona Univ., Tucson.) *In* ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 293-297 (For primary document see

N91-21986 13-89)
Copyright Avail: NTIS HC/MF A17; EPD, ESTEC, Noordwijk, Netherlands, HC 80 Dutch guilders

The Submillimeter Telescope (SMT) dedicated to observations in the shortest wavelength submillimeter windows (350 to 450 microns) is described. An overall reflector accuracy of 15 microns is achieved under operational conditions through the use of carbon fiber reinforced plastic in critical sections of the structure. This minimizes thermal effects under varying environmental loads. The 140 m diameter reflector is predicted to have a resolution of 10 arcseconds requiring a pointing and tracking accuracy of better than 1 arcsecond. ESA

N91-22034# Cologne Univ. (Germany, F.R.). Inst. fuer Physik.
NEW COLOGNE ACOUSTO-OPTICAL SPECTROMETER PROJECTS
Volker Tolls, R. Schieder, and G. Winnewisser *In* ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 299-305 (For primary document see N91-21986 13-89)
Copyright Avail: NTIS HC/MF A17; EPD, ESTEC, Noordwijk, Netherlands, HC 80 Dutch guilders

The state of the art of the Cologne Acousto Optical Spectrometer (AOS) development for radio astronomical purposes is presented. A summary of the important features of AOS in general is given. Two AOS projects are presented, a broadband spaceborne AOS for the Submillimeter Wave Astronomy Satellite (SWAS) and an AOS with variable resolution for the Kosma 3 m radiotelescope to be placed on the Gornergrat in Switzerland. ESA

N91-22035# Bell Telephone Labs., Inc., Holmdel, NJ.
SUBMILLIMETER ASTRONOMY FROM THE ANTARCTIC PLATEAU
Antony A. Stark *In* ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 307-309 (For primary document see N91-21986 13-89)
Copyright Avail: NTIS HC/MF A17; EPD, ESTEC, Noordwijk, Netherlands, HC 80 Dutch guilders

The Antarctic Submillimeter Telescope and Remote Observatory (AST/RO), a 1.7 m offset telescope for heterodyne spectroscopy scheduled for installation at the South Pole in 1992, is described. It is designed to be a proof of concept for a permanent Antarctic submillimeter observatory. In the future, a 15 m class telescope on the Antarctic Plateau at an altitude of 4200 m could be used to observe protogalaxies and protostars. Possibilities of international cooperation in this project are outlined. ESA

N91-22036# Rome Univ. (Italy). Dipt. di Fisica.
THE OASI OBSERVATORY IN ANTARCTICA
P. Calisse, G. DallOglio, M. T. DiBari, A. Iacoangeli, L. Martinis, P. Merluzzi, Lucio Piccirillo, Licia Pizzo, L. Rossi (Consiglio Nazionale delle Ricerche, Frascati, Italy), and C. Santillo *In* ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 311-312 Sponsored by Programma Nazionale di Ricerche in Antartide, and CNR (For primary document see N91-21986 13-89)
Copyright Avail: NTIS HC/MF A17; EPD, ESTEC, Noordwijk, Netherlands, HC 80 Dutch guilders

OASI (Italian acronym for Antarctic submillimeter infrared observatory), the first large (2.6 m diameter) infrared and sub mm telescope ever mounted in Antarctica is described. The telescope is devoted to the study of Cosmic Background Radiation (CBR) anisotropy at a very small angular scale (from a few arcmin to 1 degree). OASI is equipped with a 1.5 m diameter wobbling off axis paraboloid, the main purpose of which is to study the intermediate scale CBR anisotropy. Preliminary results on CBR anisotropy measurements and on the detection of diffuse mm dust emission are discussed. ESA

N91-22037# Observatoire de Paris-Meudon (France).
SUBMILLIMETRE OBSERVATIONS OF SOLAR-SYSTEM OBJECTS
Therese Encrenaz and Jacques Crovisier *In* ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 313-320 (For primary document see N91-21986 13-89)
Copyright Avail: NTIS HC/MF A17; EPD, ESTEC, Noordwijk, Netherlands, HC 80 Dutch guilders

The use of submillimeter spectroscopy as a tool for studying solar system objects in their gaseous phase is outlined. The strong rotational molecular lines found in this spectral range make it a particularly useful method. For planets and for Titan, trace components can be detected and in some cases the thermal profile and/or vertical distribution of molecular atmospheric compounds can be inferred. In the case of comets, minor parent molecules can be searched for with a better sensitivity than at lower frequencies. ESA

N91-22038# Centre National d'Etudes Spatiales, Toulouse (France).
AN ACTIVE TELESCOPE FOR THE SUB-MILLIMETRE PRONAOS BALLOON-BORNE PROJECT
F. Buisson and M. Duran (MATRA Espace, Toulouse, France) *In* ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 323-328 (For primary document see N91-21986 13-89)
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A telescope developed in the Frame of the PRONAOS (French acronym for national project for submillimeter observation) balloon-borne submillimeter project is described. The telescope is designed to provide maximum image stability and quality with as reduced a mass as possible. This has led to extensive use of composite materials and to the development of a semi active primary mirror made up of six segments. The position of each segment is permanently controlled by a computerized servoloop. First measurements show a global wave front error of 25 microns rms. ESA

N91-22039# Centre d'Etude Spatiale des Rayonnements, Toulouse (France).
IMAGE QUALITY OF THE PRONAOS TELESCOPE
Helene Safa *In* ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 329-334 (For primary document see N91-21986 13-89)
Copyright Avail: NTIS HC/MF A17; EPD, ESTEC, Noordwijk, Netherlands, HC 80 Dutch guilders

The effects of different image quality errors with PRONAOS (French acronym for national project for submillimeter observational) telescope are assessed using a specially developed code PRONAOS is a classical Cassegrain telescope with a 2 m diameter segmented primary mirror and a focal length of 20 m. The image quality errors assessed are due to segment figure errors (fabrication errors), segment positioning errors and telescope alignment errors. In the far submillimeter range the telescope is diffraction limited. Computed simulations therefore give the wavefront error rms, the intensity distribution in the local plane, and the encircled energy. ESA

N91-22040# Rome Univ. (Italy). Dipt. di Fisica.
A MILLIMETER AND SUBMILLIMETER BALLOON TELESCOPE FOR MEASUREMENTS OF DIFFUSE RADIATION
Paolo deBernardis, L. Amicone, P. Calisse, A. DeLuca, M. DePetris, M. Epifani, M. Gervasi, G. Guarini, Silvia Masi, and Francesco Melchiorri et al *In* ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 335-340 Sponsored by Italian Space Agency (For primary document see N91-21986 13-89)
Copyright Avail: NTIS HC/MF A17; EPD, ESTEC, Noordwijk, Netherlands, HC 80 Dutch guilders

Results of measurements of diffuse radiation anisotropy at wavelengths between 0.4 and 2 mm are reported on. The data was collected during the ARGO 1989 experiment. Sky emission, correlated with the 100 micron IRAS (Infrared Astronomy Satellite) map is detected and used for calibration. An upper limit to the anisotropy of the cosmic background radiation is estimated at 9/cm from the residual intensity fluctuations. Delta T/T values ranging

between 0.00022 and 0.0007 for angular scales between 5 and 500 minutes and Gaussian temperature fluctuations are found. ESA

N91-22041# Rome Univ. (Italy). Dipt. di Fisica.
THE TIR PROJECT: A BALLOON TELESCOPE FOR THE MEASUREMENT OF CBR ANISOTROPIES
Francesco Melchiorri, A. Boscareli, G. Cardoni, Paolo deBernardis, A. DeNinno, M. DePetris, M. Epifani, M. Gervasi, G. Guarini, and D. Mancini (Osservatorio Astronomico, Capodimonte, Naples, Italy) et al *In* ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 341-344 (For primary document see N91-21986 13-89)
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The 2.6 m TIR telescope designed to be carried at balloon altitude and to perform far infrared and millimetric observations is described. The telescope is optimized to search for Cosmic Background Radiation (CBR) anisotropies and faint diffuse mm and FIR sources. Scientific problems involved with this system and technical solutions to such problems are illustrated. Flight experience with a small (1.2 m) prototype (the ARGO 1989 telescope) is described. ESA

N91-22042# Rome Univ. (Italy). Dipt. di Fisica.
A HIGH THROUGHPUT, MULTIBAND PHOTOMETER FOR THE TIR PROJECT Progress Report
Paolo deBernardis, M. DePetris, M. Gervasi, Silvia Masi, M. Cardoni, A. DeNinno, and F. Scaramuzzi (Ente Nazionale per l'Energia Elettrica, Rome, Italy) *In* ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 345-348 (For primary document see N91-21986 13-89)
Copyright Avail: NTIS HC/MF A17; EPD, ESTEC, Noordwijk, Netherlands, HC 80 Dutch guilders

The main characteristics and technical solutions used in the development of a high throughput mm and sub mm four band photometer are outlined. The photometer is designed for astronomical observations with the ARGO and TIR balloon telescopes of the Italian Space Agency. The cryogenic components of the photometer are discussed and shown in diagrammatic form. Spectra of cosmic background radiation anisotropies are shown. Typical anisotropic emission of interstellar dust and synchrotron radiation is shown. ESA

N91-22043# Onsala Space Observatory (Sweden).
A FLEXIBLE HYBRID SPECTROMETER FOR BALLOON BORNE AND GROUND BASED (SUB)MILLIMETER WAVELENGTH ASTRONOMY
Anders Emrich *In* ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 349-352 Previously announced in IAA as A91-16296 Sponsored by Knut and Allice Wallenberg Foundation; Swedish Natural Science Research Council; and Wilhelm and Martina Lundgrens Foundation (For primary document see N91-21986 13-89)
Copyright Avail: NTIS HC/MF A17; EPD, ESTEC, Noordwijk, Netherlands, HC 80 Dutch guilders

A flexible spectrometer architecture consisting of standard units that can be configured to meet different requirements is described. Future designs for larger systems and satellite applications are outlined. The spectrometer is a hybrid of an analog filter and digital autocorrelator design. Two applications for the spectrometer are presented. A balloon borne submillimeter radio astronomy spectrometer using a compact low power design is described. A millimeter imaging spectrometer with a much more powerful and flexible system is also described. ESA

N91-22044# Royal Observatory, Edinburgh (Scotland).
SCUBA: A SUBMILLIMETRE CAMERA
Walter K. Gear and Colin R. Cunningham *In* ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 353-358 (For primary document see N91-21986 13-89)
Copyright Avail: NTIS HC/MF A17; EPD, ESTEC, Noordwijk, Netherlands, HC 80 Dutch guilders

The Submillimeter Common User Bolometer Array instrument (SCUBA) built at the Royal Observatory Edinburgh for the James Clerk Maxwell Telescope (JCMT) is described. The instrument contains two arrays of individual conical feed horns hexagonally packed with single mode waveguide feeding bolometers at 0.1 K cooled by a dilution refrigerator. SCUBA is predicted to allow for significant advances in the study of the solar system as well as in stellar, galactic and extragalatic cosmology. ESA

N91-22045# London Univ. (England). Dept. of Physics.
PERFORMANCE TESTS ON Ge:Ga AND Ge:Be DETECTORS FOR THE ISO LONG WAVELENGTH SPECTROMETER
Matt Griffin, Peter Ade, Sarah Church, Alexander Murray, Michael Overhamm, Rudolf Faymonville, and Su Ying Wang (Beijing Inst. of Control Engineering, China) *In* ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 359-364 (For primary document see N91-21986 13-89)
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The configuration of the detectors in the Long Wavelength Spectrometer (LWS) flown on the Infrared Space Observatory (ISO) satellite is described. The results of sensitivity and spectral response measurements on prototype detectors and filters are outlined. Spectral response profiles are presented for various stressed and unstressed detectors. Dark current versus 1/T response for three detectors is shown in graphic form. The signal flow diagram for detector tests is presented. ESA

N91-22046# Space Research Organization Netherlands, Groningen. Lab. for Space Research.
THE mm AND SUB-mm WAVE PLANAR ANTENNA ARRAYS FOR SIS DETECTORS **c33**
Herman vandeStadt, Thijs deGraauw, and A. Skalare *In* ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 365-368 (For primary document see N91-21986 13-89)
(Contracts ESA-6648/86/NL/PB; ESA-7898/88/NL/PB(SC))
Copyright Avail: NTIS HC/MF A17; EPD, ESTEC, Noordwijk, Netherlands, HC 80 Dutch guilders

The design, construction and tests of planar antennas and arrays suitable for integration with SIS (superconducting tunnel junctions) in the sub mm wavelength regime are discussed. Two different types of planar antennas are investigated, both with and without the use of lenses. It is concluded that log periodic antennas are very wideband but suffer from irregular beam shapes and a large degree of cross polarization. The dipoles are more narrow band and have low cross polarization and regular, symmetric beam patterns. ESA

N91-22047# Max-Planck-Inst. fuer Radioastronomie, Bonn (Germany, F.R.).
AIRBORNE HETERODYNE RECEIVER FOR THE RANGE 600 GHz TO 3,000 GHz **c33**
Hans Peter Roeser, Johannes Schmid-Burgk, Gerhard W. Schwaab, and Ruth U. Titz *In* ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 369-373 (For primary document see N91-21986 13-89)
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The heterodyne receiver system used aboard the Kuiper Airborne Observatory is described. High resolution detections of CO(J = 7-6, 9-8, 11-10, 12-11 and 14-13), are presented. The down converted signal is amplified by low noise amplifiers and decomposed by an acousto-optical spectrometer. The spectrometer has a maximum bandwidth of 1200 MHz with a resolution of 1.8 MHz. At 3000 GHz, this yields an instantaneous velocity range of 150 km/sec with a resolution of 0.2 km/sec. ESA

N91-22048# Royal Observatory, Edinburgh (Scotland).
RADIATIVELY-COOLED TELESCOPES FOR INFRARED SPACE ASTRONOMY
Terence J. Lee, T. G. Hawarden, H. A. Thronson (Wyoming Univ., Laramie.), C. M. Mountain, J. K. Davies, and M. S. Longair *In*

ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 375-379 (For primary document see N91-21986 13-89)
Copyright Avail: NTIS HC/MF A17; EPD, ESTEC, Noordwijk, Netherlands, HC 80 Dutch guilders

A class of Passively cooled Orbiting Infrared Observatory Telescopes (POIROT) studied for both in-orbit and lunar use is described. These longlived large aperture facilities use a mixture of radiative and mechanical cooling of optics and detectors. The telescope optics equilibrate at between 30 and 70 K. Although POIROTs are much warmer than cryogenic telescopes, radiation from the telescope is less than that from the astronomical background at wavelengths shortward of 20 to 40 microns. ESA

N91-22049*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
TELESCOPE TECHNOLOGY FOR SPACE-BORNE SUBMILLIMETER ASTRONOMY
David H. Lehman and George Helou *In* ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 381-386 (For primary document see N91-21986 13-89)
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The Precision Segmented Reflector (PSR) project which is developing telescope technology needed for future spaceborne submillimeter astronomy missions is described. Four major technical areas are under development. Lighweight composite mirrors and associated materials, precision structures and segmented reflector figure sensing and control are discussed. The objectives of the PSR project, approaches, and project technology status, are reported. ESA

N91-22050# Stockholm Observatory (Sweden).
MOSES: A PROPOSED SWEDISH SUBMILLIMETER SATELLITE FOR COMBINED ASTRONOMICAL AND ATMOSPHERIC OBSERVATIONS **c18**
Lennari Nordh, J. Askne, R. S. Booth, Andews Emrich, Urban Frisk, A. Hjalmarsson, S. Jacobsson, Erik Kollberg, D. Murtagh (Stockholm Univ., Sweden), and G. Olofsson et al *In* ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 387-389 (For primary document see N91-21986 13-89)
Copyright Avail: NTIS HC/MF A17; EPD, ESTEC, Noordwijk, Netherlands, HC 80 Dutch guilders

A Swedish satellite for combined astronomical and atmospheric submillimeter observations is described. The molecules in the Outer Space and in the Earth's Stratosphere (MOSES) project is intended for presentation for project approval at the end of 1991. The main astronomical objective of MOSES is to perform detailed studies of the chemistry and physics in a few selected sources by observing lines from key species and by spectral scans of limited spectral regions. Data from the satellite is to be combined with data from ground based sub mm telescopes such as SEST (Swedish ESO Submillimeter Telescope). ESA

N91-22051# Tokyo Univ. (Japan).
THE UNIVERSITY OF TOKYO-NORBEYAMA RADIO OBSERVATORY SUBMILLIMETER SURVEY TELESCOPE
Seiichi Sakamoto, T. Hasegawa, M. Hayashi, T. Handa, K. Sunada, and Norio Kaifu (Tokyo Astronomical Observatory, Mitaka, Japan) *In* ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 391-395 (For primary document see N91-21986 13-89)
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A 60 cm submillimeter telescope optimized for survey operations is described. The main task of this telescope is to survey the Galactic plane in CO (J = 2-1) emission with the same angular resolution as the CfA CO (J = 1-0) survey. Direct comparison of each set of data allows information on the large scale temperature structure of the Galaxy to be derived. Copies of the telescope planned for operation at higher frequencies, CI (490 GHz) or CO (J = 3-2) (345 GHz) are described. ESA

N91-22052# Hawaii Univ., Honolulu. Inst. for Astronomy.
SUBMILLIMETRE PHOTOMETRY OF COMETS
David Jewitt and Jane Luu (Harvard-Smithsonian Center for Astrophysics, Cambridge, MA.) *In* ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 397-399 (For primary document see N91-21986 13-89)
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Initial submillimeter continuum photometry of comets and the resulting implications for large particles in comets are discussed. Measurements carried out during the Giotto and Vega Halley comet encounters are discussed. Two conclusions are made about cometary grains. One is that the rate of supply of mass to meteor streams and the zodiacal cloud may be significantly larger than previously known. The second conclusion is that there is independent evidence for large grains both in the stellar disks and in the comets thought to have been formed within these disks. ESA

N91-22053*# Smithsonian Astrophysical Observatory, Cambridge, MA.
A SEARCH FOR STELLAR OCCULTATIONS BY URANUS, NEPTUNE, PLUTO, AND THEIR SATELLITES: 1990-1999 Final Report, 1 Jan. 1989 - 31 Dec. 1990
Douglas J. Mink Mar. 1991 47 p
(Grant NAGw-1490)
(NASA-CR-188146; NAS 1.26:188146) Avail: NTIS HC/MF A03 CSCL 03A

A search for occultations of stars by Uranus, Neptune, and Pluto between 1990 and 1999 was carried out by combining ephemeris information and star positions using very accurate occultation modeling software. Stars from both the Space Telescope Guide Catalog and photographic plates taken by Arnold Klemola at Lick Observatory were compared with planet positions from the JPL DE-130 ephemeris, with local modifications for Pluto and Charon. Some 666 possible occultations by the Uranian ring, 143 possible occultations by Neptune, and 40 possible occultations by Pluto and/or Charon were found among stars with visual magnitudes as faint as 16. Before the star positions could be obtained, the occultation prediction software was used to aid many observers in observing the occultation of 28 Sagitarii by Saturn in July 1989. As a test on other outer solar system objects, 17 possible occultations were found in a search of the Guide Star Catalog for occultations by 2060 Chiron, and interesting object between Saturn and Uranus which shows both cometary and asteroidal properties. Author

90 ASTROPHYSICS

Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust.
For related information see also *75 Plasma Physics*.

N91-22054# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
NGC3309: AN S-SHAPED RADIO GALAXY IN A NEARBY CLUSTER
C. Kotanyi Sep. 1990 7 p Submitted for publication
(INPE-5143-PRE/1631) Avail: NTIS HC/MF A02

A very large array (VLA) map at 1.4 GHz is presented of NGC3309, one of a pair of giant elliptical galaxies dominating the center of the Hydra cluster (Abell 1060). The galaxy shows an S-shaped radio source similar to M84 in Virgo and NGC708 in Abell 262. The small size and low luminosity of these radio sources could be due to a recent tidal interaction responsible for their S-shape. Author

N91-22055# Fermi National Accelerator Lab., Batavia, IL.
INDIRECT DETECTION OF HEAVY SUPERSYMMETRIC DARK MATTER
M. Kamionkowski (Chicago Univ., IL.) Feb. 1991 5 p Presented at the International Conference on Trends in Astroparticle Physics,

Santa Monica, 26 Nov. - 1 Dec. 1990
(Contract DE-AC02-76CH-03000)
(DE91-009669; FNAL/C-91/61-A; CONF-901141-3) Avail: NTIS HC/MF A01

If neutralinos reside in the galactic halo they will be captured in the Sun and annihilate therein producing high-energy neutrinos. Present limits on the flux of such neutrinos from underground detectors such as IMB and Kamiokande 2 may be used to rule out certain supersymmetric dark-matter candidates, while in many other supersymmetric models the rates are large enough that if neutralinos do reside in the galactic halo, observation of a neutrino signal may be possible in the near future. DOE

N91-21992# University Coll., Cardiff (Wales). School of Mathematics.
THE MICROWAVE BACKGROUND: ITS SMOOTHNESS AND FREQUENCY DISTRIBUTION AS AN ASTROPHYSICAL PRODUCT
Fred Hoyle, N. C. Wickramasinghe, and Geoffrey Burbidge (California Univ., San Diego, La Jolla.) *In* ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 59-63 (For primary document see N91-21986 13-89)
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N91-21998# Academy of Sciences (USSR), Moscow. Inst. of Space Research.
RELICT 2 PROJECT: SCIENTIFIC PROGRAM AND STRUCTURE
Igor Strukov, D. Skulachev, N. Budilovich, Yu. Nemlikher, V. Korogod, A. Kosov, A. Rukavicin, V. Aniskovich, and R. Borovski *In* ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 99-104 (For primary document see N91-21986 13-89)
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N91-22000# Lancaster Univ. (England). Dept. of Physics and Astronomy.
THE IMPORTANCE OF SUBMILLIMETRE OBSERVATIONS OF RADIO QUIET AND RADIO LOUD AGN'S
Ian Robson, David Hughes, and Walter K. Gear (Royal Observatory, Edinburgh, Scotland) *In* ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 11-115 (For primary document see N91-21986 13-89)
Copyright Avail: NTIS HC/MF A17; EPD, ESTEC, Noordwijk, Netherlands, HC 80 Dutch guilders

N91-22011# Ecole Normale Superieure, Paris (France).
THE STUCTURE OF MOLECULAR CLOUDS: NEW QUESTIONS
Edith Falgarone *In* ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 173-178 (For primary document see N91-21986 13-89)
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N91-22014# Max-Planck-Inst. fuer Radioastronomie, Bonn (Germany, F.R.).
A HIGHLY COLLIMATED BIPOLAR OUTFLOW IN THE CORE OF OMC-1: CO SUBMILLIMETER EMISSION
Johannes Schmid-Burgk, Hans Peter Roeser, Gerhard W. Schwaab, and Ruth U. Titz *In* ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 193-195 (For primary document see N91-21986 13-89)
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91 LUNAR AND PLANETARY EXPLORATION

Includes planetology; and manned and unmanned flights.
For spacecraft design or space stations see *18 Spacecraft Design, Testing and Performance.*

N91-22056*# California Univ., Los Angeles. Inst. of Geophysics and Planetary Physics.
DATA ANALYSIS FOR THE PIONEER-VENUS ELECTRIC FIELD DETECTOR Report, 26 Sep. 1990 - 25 Mar. 1991
1991 21 p
(Grant NAG2-485)
(NASA-CR-188099; NAS 1.26:188099) Avail: NTIS HC/MF A03 CSCL 03B

Research on plasma waves observed in the ion foreshock at Venus and on the impulsive bursts observed in the nightside ionosphere was performed. Some results from the ion foreshock, wave polarization, and the dependence on magnetic field orientation studies are described. An analysis of data acquired using 4096 BPS data is also presented. Author

N91-22057*# Georgia Inst. of Tech., Atlanta. School of Electrical Engineering.
LABORATORY EVALUATION AND APPLICATION OF MICROWAVE ABSORPTION PROPERTIES UNDER SIMULATED CONDITIONS FOR PLANETARY ATMOSPHERES Semiannual Status Report No. 15, 1 Nov. 1990 - 30 Apr. 1991
Paul G. Steffes 1991 57 p
(Grant NAGw-533)
(NASA-CR-188096; NAS 1.26:188096) Avail: NTIS HC/MF A04 CSCL 03B

Laboratory measurements of microwave and millimeter wave properties of the simulated atmosphere of the outer planets and their satellites has continued. One of the focuses is on the development of a radiative transfer model of the Jovian atmosphere at wavelengths from 1 mm to 10 cm. This modeling effort led to laboratory measurements of the millimeter wave opacity of hydrogen sulfide (H2S) under simulated Jovian conditions. Descriptions of the modeling effort, the Laboratory experiment, and the observations are presented. Correlative studies of measurements with Pioneer-Venus radio occultation measurements with longer wavelength emission measurements have provided new ways for characterizing temporal and spatial variations in the abundance of both gases H2SO4 and SO2, and for modeling their roles in the subcloud atmosphere. Laboratory measurements were conducted on 1.35 cm (and 13 cm) opacity of gaseous SO2 and absorptivity of gaseous SO2 at the 3.2 mm wavelength under simulated Venus conditions. Laboratory measurements were completed on millimeter wave dielectric properties of liquid H2SO4, in order to model the effects of the opacity of the clouds of Venus onto millimeter wave emission spectrum. B.G.

N91-22058# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
ANALYSIS OF PERIODIC ORBITS ABOUT THE MARTIAN MOONS BY CONTINUATION TECHNIQUES M.S. Thesis
Frank Luria Dec. 1990 75 p
(AD-A231026; AFIT/GAE/ENY/90D-10) Avail: NTIS HC/MF A04 CSCL 03/3

From a few known periodic orbits of Phobos and Deimos, continuation techniques were used to find entire families of stable orbits. These techniques involved varying a parameter, the Hamiltonian, of the system and analyzing how the orbital behavior changed with the parameter. Floquet multipliers, for stability analysis, were also computed. AUTO86, a continuation/bifurcation software package, was used in this study. Artificial energy dissipation had to be added to the conservative Hamiltonian system to enable use of AUTO. GRA

92 SOLAR PHYSICS

Includes solar activity, solar flares, solar radiation and sunspots.

For related information see *93 Space Radiation.*

N91-22059# National Geophysical Data Center, Boulder, CO. ni483381

SOLAR-GEOPHYSICAL DATA NUMBER 553, SEPTEMBER 1990. PART 1: (PROMPT REPORTS). DATA FOR AUGUST 1990, JULY 1990, AND LATE DATA

Helen E. Coffey, ed. Sep. 1990 165 p

(PB91-113019; SGD-553-Pt-1; LC-79-640375; ISSN-0038-0911) Avail: NTIS HC/MF A08 CSCL 03B

Solar-geophysical information is presented in tabular and graphic form. Categories include: detailed index for 1990; data for August 1990 (solar-terrestrial environment, advance and worldwide IUWDS alert periods, solar activity indices, solar flares, solar radio emission, Standford mean solar magnetic field); data for July 1990 (solar active regions, sudden ionospheric disturbances, solar radio spectral observations, cosmic ray measurements by neutron monitor, and geomagnetic indices): and late data (solar radio spectral Bleien and Ondrejov, June '90, cosmic ray Hyancayo, June '90, and geomagnetic activity indices May to June '90). B.G.

N91-22060# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

SPECTRAL ANALYSIS OF ANNUAL SUNSPOT SERIES: AN UPDATE

Rajarem P. Kane and Nalin Babulal Trivedi Dec. 1990 28 p Submitted for publication

(Contract FINEP-537/CT)

(INPE-5207-PRE/1669) Avail: NTIS HC/MF A03

Maximum entropy spectral analysis (MESA) of annual sunspot series for 1700-1987 (288 points) indicated the most prominent peak at T = 10.91 years, followed by T = 10.62, 10.00, and 103 years of comparable amplitudes and twelve others of smaller amplitudes, all significant at a 3 sigma a priori level. MacDonald (1989) has suggested that the method of spectral analysis should depend upon the choice of the model chosen. However, the results compare well with his results from a periodogram study, indicating that the choice of the model, generally difficult in geophysical problems, is not vital. Since amplitude estimates in MESA are unreliable, the prescription is to use MESA only for detecting possible periodicities and then, estimate amplitudes and phases by a separate multiple regression analysis. Author

N91-22061# Texas A&M Univ., College Station.

PROTON DEPTH DOSE DISTRIBUTION: 3-D CALCULATION OF DOSE DISTRIBUTIONS FROM SOLAR FLARE IRRADIATION Interim Report, May - Nov. 1988

Dennis D. Leavitt Nov. 1990 39 p

(Contract F33615-87-D-0627)

(AD-A231230; USAFSAM-TP-90-17) Avail: NTIS HC/MF A03 CSCL 06/7

Relative depth dose distribution to the head from 3 typical solar flare proton events were calculated for 3 different exposure geometries: (1) single directional radiation incident upon a fixed head; (2) single directional radiation incident upon head rotating axially (2-D rotation); and (3) omnidirectional radiation incident upon head (3-D rotation). Isodose distributions in the transverse plane intersecting isocenter are presented for each of the 3 solar flare events in all 3 exposure geometries. In all 3 calculation configurations the maximum predicted dose occurred on the surface of the head. The dose at the isocenter of the head relative to the surface dose for the 2-D and 3-D rotation geometries ranged from 2 to 19 percent, increasing with increasing energy of the event. The calculations suggest the superficially located organs (lens of the eye and skin) are at greatest risk for the proton events studied here. GRA

93 SPACE RADIATION

Includes cosmic radiation; and inner and outer earth's radiation belts.

For biological effects of radiation see *52 Aerospace Medicine.* For theory see *73 Nuclear and High-Energy Physics.*

N91-22062# Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro.

MULTI-CORE EVENTS IN COSMIC-RAY INDUCED INTERACTIONS WITH LEAD AT AROUND 10 TeV

N. Amato and N. Arata 1989 19 p

(DE91-616827; CBPF-NF-015/89) Avail: NTIS HC/MF A03

The analysis is made on the cosmic-ray induced interactions with lead at around 10 TeV on the basis of emusion chamber data at Chacaltaya. A special attention is paid to the events detected as multi-cores under the spatial resolution of a few tens of microns. The observation of six double-core events and two triple-core events with the average invariant mass of 1.8 GeV/c(exp 2) leads to the estimation on production frequency of such multi-cores as about 5 percent at 10 TeV at the atmospheric depth 540 gr/cm(exp 2). DOE

N91-22063*# Chicago Univ., IL.

COSMIC RAY NUCLEI (CRN) DETECTOR INVESTIGATION Final Report

Peter Meyer, Dietrich Muller, Jacques LHeureux, and Simon Swordy 3 Jan. 1991 6 p

(Contract NAS8-32828)

(NASA-CR-184137; NAS 1.26:184137) Avail: NTIS HC/MF A02 CSCL 03B

The Cosmic Ray Nuclei (CRN) detector was designed to measure elemental composition and energy spectra of cosmic radiation nuclei ranging from lithium to iron. CRN was flown as part of Spacelab 2 in 1985, and consisted of three basic components: a gas Cerenkov counter, a transition radiation detector, and plastic scintillators. The results of the experiment indicate that the relative abundance of elements in this range, traveling at near relativistic velocities, is similar to those reported at lower energy. Author

N91-22064# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

AN UNUSUAL CASE OF METER WAVE TYPE-3 BURSTS LEADING MILLIMETER-WAVE BURSTS

R. H. Trevisan, H. S. Sawant, P. Zlobec, and M. Messerotti (Osservatorio Astronomico, Trieste, Italy) Sep. 1990 4 p

(INPE-5140-PRE/1628) Avail: NTIS HC/MF A01

Observations of meter gamma ray (408, 327, 237 MHz) type-III bursts were compared with millimeter wave (22 GHz) bursts obtained simultaneously with high (less than 100 m) absolute timing accuracy. In a majority of the cases, meter gamma ray type-III bursts are peaked later when compared to millimeter gamma rays associated bursts and are poorly correlated. Here, for the first time, one to one correlated intense, high (45) R-circularly polarized, meter gamma ray type-III bursts are reported, which peak earlier in comparison with associated extremely weak, less L-circularly polarized, 22 GHz bursts. Assuming this millimeter gamma ray burst to be of thermal origin, then depending upon the ratio of time heating to time of acceleration, and time of commencement of heating at the level where millimeter gamma ray burst is produced, these delays are interpreted. Author

N91-21995# Osservatorio Astronomico, Padova (Italy).

EXTRAGALACTIC SOURCE COUNTS, CONFUSION LIMITS AND CONTRIBUTIONS TO THE BACKGROUND RADIATION IN THE SUB-mm

Alberto Franceschini, L. Danese, G. DeZotti, P. Mazzei, and L. Toffolatti (Padua Univ., Italy) *In* ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 79-84 (For primary document see N91-21986 13-89)

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N91-22004# Tokyo Univ., Sagamihara (Japan). Inst. of Space and Astronautical Science.
LARGE-SCALE (CII) 158 MICRON EMISSION OF THE GALAXY OBSERVED BY A BALLOON-BORNE TELESCOPE
Hiroshi Shibai, Haruyuki Okuda, T. Nakagawa, H. Matsuhara, T. Maihara, K. Mizutani, Y. Kobayashi, N. Hiromoto, T. Nishimura, and F. J. Low (Arizona Univ., Tucson.) *In* ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 141-147 (For primary document see N91-21986 13-89)
Copyright Avail: NTIS HC/MF A17; EPD, ESTEC, Noordwijk, Netherlands, HC 80 Dutch guilders

N91-22007# Max-Planck-Inst. fuer Radioastronomie, Bonn (Germany, F.R.).
THE 1.3 mm CONTINUUM EMISSION FROM CIRCUMSTELLAR ENVELOPES
Charles Malcolm Walmsley, R. Chini, Ernst Kreysa, H. Steppe, P. Andre, Thierry Forveille, and A. Omont (Centre d'Etudes et de Recherche de la Machine-Outil, Saint-Martin-d'Heres, France) *In* ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 155-157 (For primary document see N91-21986 13-89)
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N91-22010# Max-Planck-Inst. fuer Physik und Astrophysik, Garching (Germany, F.R.).
COHERENT AND INCOHERENT DETECTION
Andrew I. Harris *In* ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 165-169 (For primary document see N91-21986 13-89)
Copyright Avail: NTIS HC/MF A17; EPD, ESTEC, Noordwijk, Netherlands, HC 80 Dutch guilders

N91-22029# Leiden Univ. (Netherlands).
THE 0 DEG (63 MICRON) LINE EMISSION FROM GALACTIC HIGH LATITUDE CIRRUS CLOUDS
Ronald Stark *In* ESA, From Ground-Based to Space-Borne Sub-mm Astronomy Dec. 1990 p 275-278 (For primary document see N91-21986 13-89)
Copyright Avail: NTIS HC/MF A17; EPD, ESTEC, Noordwijk, Netherlands, HC 80 Dutch guilders

99 GENERAL

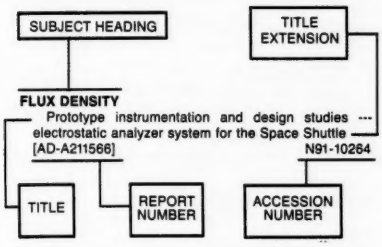
N91-22065*# National Aeronautics and Space Administration, Washington, DC.
THE 1991/92 GRADUATE STUDENT RESEARCHERS PROGRAM, INCLUDING THE UNDERREPRESENTED MINORITY FOCUS COMPONENT
1991 101 p Original contains color illustrations
(NASA-TM-101801; NAS 1.15:101801) Avail: NTIS HC/MF A06; 1 functional color page CSCL 05B

The Graduate Student Research Program (GSRP) was expanded in 1987 to include the Underrepresented Minority Focus Component (UMFC). This program was designed to increase minority participation in graduate study and research, and ultimately, in space science and aerospace technology careers. This booklet presents the areas of research activities at NASA facilities for the GSRP and summarizes and presents the objectives of the UMFC. E.R.

N91-22066*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
NASA AMES AEROSPACE SYSTEMS DIRECTORATE RESEARCH
James A. Albers Mar. 1991 55 p
(NASA-TM-103844; A-91088; NAS 1.15:103844) Avail: NTIS HC/MF A04 CSCL 05D

The Aerospace Systems Directorate is one of four research directorates at the NASA Ames Research Center. The Directorate conducts research and technology development for advanced aircraft and aircraft systems in intelligent computational systems and human-machine systems for aeronautics and space. The Directorate manages research and aircraft technology development projects, and operates and maintains major wind tunnels and flight simulation facilities. The Aerospace Systems Directorate's research and technology as it relates to NASA agency goals and specific strategic thrusts are discussed. Author

Typical Subject Index Listing



The subject heading is a key to the subject content of the document. Titles, report numbers, and accession numbers of pertinent documents are provided under each subject heading. When the title is insufficiently descriptive of the document content, a title extension has been added, separated from the title by three hyphens. The report number helps to indicate the type of document cited (e.g., NASA report, NASA translation, NASA contractor report). The accession number is the number by which the document abstracts are arranged in this journal and by which the document is sold or requested. The titles, with title extensions if present, are arranged under each subject heading in ascending accession number order. The subject headings have been selected from the latest revision of the *NASA Thesaurus* (NASA SP-7064).

A

ABLATION
Surface cleaning by laser ablation
[DE91-009189] N91-21505
ABSORBENTS
A systematic investigation of the preparation and properties of composite carbon molecular sieves containing inorganic oxides N91-21353
ABSORPTION SPECTRA
Study of the absorption lines widened by the effect of pressure, emitted by the combustion gases of propulsive powders
[ISL-R-124/89] N91-21237
Proof of the feasibility of coherent and incoherent schemes for pumping a gamma ray laser
[AD-A230897] N91-21520
Observation of spectral diffusion in crystals using single impurity molecules
[AD-A231338] N91-21926
ABSORPTION SPECTROSCOPY
In-situ x ray measurements of pit solutions during localized corrosion
[DE91-006916] N91-21295
Preliminary field demonstration of a fiber-optic TCE sensor
[DE91-008453] N91-21498
ABSORPTIVITY
Modeling the absorption of intense, short laser pulses in steep density gradients
[DE91-008735] N91-21503
Strange particles production and absorption in nuclei at high energies
[DE91-620399] N91-21845
ABSTRACTS
Environmental Research Laboratories publication abstracts, fiscal year 1990
[PB91-132035] N91-21627
Large eddy simulation: Where do we stand
[AD-A230835] N91-21657
Radiation health research, 1986 - 1990
[NASA-TM-4270] N91-21704
ACCELERATION (PHYSICS)
Distributed Minimal Residual (DMR) method for acceleration of iterative algorithms N91-21077
An examination of anticipated g-jitter on space station and its effects on materials processes
[NASA-TM-103775] N91-21378
ACCELERATION PROTECTION
High G physiological protection training
[AGARD-AG-322] N91-21720
ACCELERATION STRESSES (PHYSIOLOGY)
Enhancing tolerance to acceleration (+Gz) stress: The Hook maneuver
[AD-A231094] N91-21707
High G physiological protection training
[AGARD-AG-322] N91-21720
ACCELERATION TOLERANCE
Physiology data acquisition system description
[AD-A231088] N91-21706
Enhancing tolerance to acceleration (+Gz) stress: The Hook maneuver
[AD-A231094] N91-21707
ACCEPTOR MATERIALS
Subthreshold I-V characteristics of AlGaAs/GaAs MODFETs: The role of unintentional acceptors
[AD-A230110] N91-21904
ACCESS CONTROL
Documentation for the token ring network simulation system
[NASA-CR-188093] N91-21789
Queueing models for token and slotted ring networks
[NASA-CR-188091] N91-21791
ACCOMMODATION
Aerobrake assembly with minimum Space Station accommodation
[NASA-TM-102778] N91-21183
ACCURACY
Angle measurements with the laser gyro GG 1342
[ESA-TT-1212] N91-21490
Measurement capabilities of the Sandia, Livermore, Standards Laboratories
[DE91-008124] N91-21825
The Submillimeter Telescope (SMT) N91-22033
ACETONE
Artifact diamond characterization
[AD-A231555] N91-21323
ACETYLACETONE
Preparation and characterization of Iron(III) oxide films by an novel spray pyrolysis method
[AD-A231047] N91-21920
ACETYLENE
Ab initio study of the electric dipole transition moment for the electronic X to C transition in acetylene: Theoretical predictions of the absorption and magnetic circular dichroism intensities
[AD-A231227] N91-21442
ACOUSTIC EMISSION
Acoustic emission-fracture strength relations for Al/Gr composites
[DE91-009106] N91-21251
ACOUSTIC LEVITATION
Containerless processing in the European microgravity programme N91-21337
Drop evaporation in a single-axis acoustic levitator N91-21356
Rheological properties, shape oscillations, and coalescence of liquid drops with surfactants N91-21357
Optical scattering methods applicable to drops and bubbles N91-21358
Undercooling of acoustically levitated molten drops N91-21359
High temperature acoustic and hybrid microwave/acoustic levitators for materials processing N91-21368
A computer model of the electrostatic positioning system N91-21371
Some considerations for various positioning systems and their science capabilities N91-21372
Drop coalescence studies N91-21375
Oscillational instabilities in single mode acoustics levitators N91-21376
ACOUSTIC MEASUREMENT
Acoustic emission-fracture strength relations for Al/Gr composites
[DE91-009106] N91-21251
ACOUSTIC PROPAGATION
Propagation of helicopter noise in the low atmosphere layers
[ISL-CO-203/90] N91-21830
ACOUSTIC SCATTERING
High-frequency acoustic scattering
[AD-A230880] N91-21836
Transient solutions from scattered fields in a waveguide
[AD-A231124] N91-21838
FY 1989 acoustics research
[AD-A231499] N91-21840
ACOUSTIC SOUNDING
Audiomagnetotelluric (AMT) soundings in the proximity of the Camaqua (RS) mines
[INPE-5213-RPE/641] N91-21651
ACOUSTIC VELOCITY
Analysis of 200 Hz CW tone propagation signal recorded during the September 1987 VLA experiment
[AD-A231053] N91-21414
ACOUSTICS
High temperature acoustic and hybrid microwave/acoustic levitators for materials processing N91-21368
A new, simple electrostatic-acoustic hybrid levitator N91-21369
Computer animation of NASTRAN displacements on IRIS 4D-series workstations: CANDI/ANIMATE postprocessing of NASHUA results
[DE91-008605] N91-21585
The sound of moving bodies
[NASA-TM-103342] N91-21827
FY 1989 acoustics research
[AD-A231499] N91-21840
ACOUSTO-OPTICS
New Cologne acousto-optical spectrometer projects N91-22034
Airborne heterodyne receiver for the range 600 GHz to 3,000 GHz N91-22047
ACTIVATION
Construction site Voice Operated Information System (VOIS) test
[AD-A231633] N91-21424
ACTIVATION (BIOLOGY)
In vitro photoreactivation of transforming DNA of Bacillus subtilis spores after irradiation by ultraviolet light
[ESA-TT-1210] N91-21699
ACTIVE CONTROL
Hot-bench simulation of the active flexible wing wind-tunnel model
[NASA-TM-102758] N91-21144
Microgravity vibration isolation: An optimal control law for the one-dimensional case N91-21206
Measurement and calculation of forces in a magnetic journal bearing actuator N91-21207
ACTIVE GALACTIC NUCLEI
The importance of submillimetre observations of radio quiet and radio loud AGN's N91-22000
ACTS
Design of experiments to quantify communication satellite system performance
[PB91-129635] N91-21395
ACTUATORS
Magnetic suspension systems for space applications N91-21189
A superconducting large-angle magnetic suspension N91-21191
Sliding mode control of magnetic suspensions for precision pointing and tracking applications N91-21193
Magnetic bearings for a spaceflight optical disk recorder N91-21195
Measurement and calculation of forces in a magnetic journal bearing actuator N91-21207
Single element magnetic suspension actuator
[NASA-CASE-LAR-13981-1] N91-21539

Passive dynamic controllers for nonlinear mechanical systems
[NASA-TM-104047] N91-21573
Permanent magnet flux-biased magnetic actuator with flux feedback
[NASA-CASE-LAR-13785-1] N91-21824

ADA (PROGRAMMING LANGUAGE)
Determining concurrency in object-oriented design of real-time embedded systems using Ada
[AD-A230659] N91-21738
An object oriented design and implementation of the IDEF(sub 0) essential model using Ada and an Ada based expert system
[AD-A230814] N91-21753

ADAPTATION
Adaptive detection in subspaces
[AD-A231023] N91-21876

ADAPTIVE CONTROL
Advanced magnetic suspensions for vibration isolation and fast-attitude control of space-based generic pointing mounts N91-21190
Parallel computations and control of adaptive structures N91-21732
Adaptive output-feedback control of systems with output nonlinearities
[AD-A231249] N91-21793

ADAPTIVE FILTERS
Excision techniques in direct sequence spread spectrum communication systems
[AD-A231290] N91-21763

ADHESION
Effective cleaning of oil-protected bearing steel examined by XPS analysis. Part 1: Cleaning by solvents and alkaline cleaners
[NAL-TR-1074] N91-21538

ADHESIVES
Synthesis of imide/arylene ether copolymers for adhesives and composite matrices
[NASA-TM-104067] N91-21306

ADIABATIC CONDITIONS
Volumetric measurement of tank volume
[NASA-CASE-MSC-21500-1] N91-21493

ADVANCED LAUNCH SYSTEM (STS)
Quality function deployment in launch operations
[AD-A230983] N91-21178

ADVANCED VERY HIGH RESOLUTION RADIOMETER
AVHRR/NOAA imagery navigation from the geodetic reference matrix: Studies and evaluations
[INPE-5216-PRE/1672] N91-21126
Comparative analysis of AVHRR/NOAA and TM/LANDSAT data in the delimitation of savanna/forest contact area: Preliminary results
[INPE-5200-RPE/639] N91-21611

ADVECTION
Stratus surge prediction along the Central California coast
[PB91-129239] N91-21668

AERIAL PHOTOGRAPHY
Data integration of different sensor systems through the technique of IHS transformation, the purpose and study of intra-urban structure
[INPE-5171-PRE/1640] N91-21616

AERIAL RECONNAISSANCE
Supervision of peat stockpiles using aerial thermography
[DE91-752966] N91-21622

AEROACOUSTICS
Acoustic and aerodynamic study of a pusher-propeller aircraft model
[NASA-TP-3040] N91-21828

AEROASSIST
Estimates of thermochemical relaxation lengths behind normal shock waves relevant to manned lunar and Mars return missions, the aeroassist flight experiment, and Mars entry
[NASA-TM-102879] N91-21471

AEROBES
Aerobic production of ethanol
[PB91-119172] N91-21324
Comparison of the activity of subsurface and surface microorganisms and their anaerobic transformation of heterocyclic compounds
[DE91-008839] N91-21703

AEROBRAKING
Evaluation of transportation systems for advanced spaceflight missions
[DLR-FB-90-39] N91-21181
Aerobrake assembly with minimum Space Station accommodation
[NASA-TM-102778] N91-21183

AEROCAPTURE
Parametric entry corridors for lunar/Mars aerocapture missions
[NASA-TM-102178] N91-21168

AERODYNAMIC CHARACTERISTICS
Infrared thermography for the qualitative aerodynamic study of a slender body
[ISL-R-122/89] N91-21104
Bifurcation analysis of the longitudinal dynamics of a simple powered lifting hypersonic vehicle
[AD-A230826] N91-21118
Identification of the aerodynamic model of the DLR research aircraft ATTAS from flight test data
[DLR-FB-90-40] N91-21130
Rotary-balance testing for aircraft dynamics
[AGARD-AR-265] N91-21156

AERODYNAMIC COEFFICIENTS
Comparison study of the aerodynamic coefficients measured on models with circular or squared section and large elongation in supersonic flow
[ISL-R-125/89] N91-21106

AERODYNAMIC CONFIGURATIONS
Low speed wind tunnel investigation of propeller slipstream aerodynamic effects on different nacelle/wing combinations. Part 2: Propeller slipstream flow field surveys (velocity components, dynamic, total and static pressure distributions) at zero angle of attack and high power
[FFA-TN-1990-24-PT-2] N91-21109
Application of mesh generation to complex 3-D configurations
[AGARD-AR-268] N91-21464
Advanced rotorcraft transmission program
[NASA-TM-103276] N91-21531

AERODYNAMIC DRAG
Practical methods to evaluate the friction drag coefficient of a projectile in free flight
[ISL-R-123/89] N91-21105

AERODYNAMIC FORCES
A modal aeroelastic analysis scheme for turbomachinery blading
[NASA-CR-187089] N91-21138
STARS: An integrated general-purpose finite element structural, aeroelastic, and aeroservoelastic analysis computer program
[NASA-TM-101709-REV] N91-21587

AERODYNAMIC HEATING
Finite element methods for integrated aerodynamic heating analysis
[NASA-CR-188079] N91-21101

AERODYNAMIC INTERFERENCE
Description and evaluation of an interference assessment for a slotted-wall wind tunnel
[NASA-CR-4352] N91-21155

AERODYNAMIC NOISE
A study of rotor broadband noise mechanisms and helicopter tail rotor noise
[NASA-CR-177565] N91-21829
Propagation of helicopter noise in the low atmosphere layers
[ISL-CO-203/90] N91-21830

AERODYNAMICS
Low speed wind tunnel investigation of propeller slipstream aerodynamic effects on different nacelle/wing combinations. Part 2: Propeller slipstream flow field surveys (velocity components, dynamic, total and static pressure distributions) at zero angle of attack and high power
[FFA-TN-1990-24-PT-2] N91-21109
Possibilities of trajectory modification
[ISL-CO-209/90] N91-21151

AEROELASTICITY
Prediction of unsteady transonic separated flow for missile applications
[AD-A231259] N91-21120
A modal aeroelastic analysis scheme for turbomachinery blading
[NASA-CR-187089] N91-21138
STARS: An integrated general-purpose finite element structural, aeroelastic, and aeroservoelastic analysis computer program
[NASA-TM-101709-REV] N91-21587
The sound of moving bodies
[NASA-TM-103342] N91-21827

AEROGELS
Organic aerogels: A new type of ultrastructured polymer
[DE91-008500] N91-21312

AEROMAGNETISM
Geodynamics branch data base for main magnetic field analysis
[NASA-TM-104542] N91-21653

AERONOMY
Environmental Research Laboratories publication abstracts, fiscal year 1990
[PB91-132035] N91-21627

AEROSOLS
Sampling and characterization of aerosols
[LUNDD/TMAT-90/2002] N91-21269
Comparison of UNL laser imaging and sizing system and a phase Doppler system for analyzing sprays from a NASA nozzle
[NASA-CR-185239] N91-21485
Report of the panel on volcanology, section 4 N91-21593
Volcanism-Climate Interactions
[NASA-CP-10062] N91-21641
Historical evidence for a connection between volcanic eruptions and climate change N91-21642
Climatic impact of volcanic eruptions N91-21643
Sources of volcanic aerosols: Petrologic and volcanological constraints N91-21644
Volcanic aerosols: Chemistry, evolution, and effects N91-21645

AEROSPACE ENGINEERING
Aerospace Applications of Magnetic Suspension Technology, part 1
[NASA-CP-10066-PT-1] N91-21188
Aeronautics and space technology N91-21981
NASA Ames aerospace systems directorate research
[NASA-TM-103844] N91-22066

AEROSPACE ENVIRONMENTS
Experiments in thrusterless robot locomotion control for space applications
[NASA-CR-188027] N91-21528

AEROSPACE MEDICINE
Exploring the living universe: A strategy for space life sciences
[NASA-TM-103399] N91-21696
An annotated bibliography of hypobaric decompression sickness research conducted at the Crew Technology Division, USAF School of Aerospace Medicine, Brooks AFB, Texas from 1983 to 1988
[AD-A231355] N91-21710

AEROSPACE SAFETY
The indirect economic effects of the European Space Agency programs
[ESA-BR-63] N91-21975

AEROSPACE SCIENCES
Space research in Norway N91-21167
NASA/DoD aerospace knowledge diffusion research project. Paper 9: Information intermediaries and the transfer of aerospace Scientific and Technical Information (STI). A report from the field
[NASA-TM-103384] N91-21959
The 1991/92 graduate student researchers program, including the underrepresented minority focus component
[NASA-TM-101801] N91-22065

AEROSPACE SYSTEMS
National plan for aviation human factors, volume 1
[PB91-100339] N91-21712
NASA Ames aerospace systems directorate research
[NASA-TM-103844] N91-22066

AEROSPACE TECHNOLOGY TRANSFER
The indirect economic effects of the European Space Agency programs
[ESA-BR-63] N91-21975

AEROSPACE VEHICLES
Materials for aerospace vehicles friction drag reduction surfaces
[INPE-5188-PRE/1656] N91-21217
The study of plasma clouds around large active space structures
[AD-A230634] N91-21881

AEROTHERMOCHEMISTRY
The direct simulation of high-speed mixing-layers without and with chemical heat release N91-21095

AFTERBODIES
Solution of three-dimensional afterbody flow using reduced Navier-Stokes equations N91-21093

AFTERBURNING
Evaluation of air injection in a sudden expansion diffuser for real-time afterburning application
[AD-A230850] N91-21141

AFTERGLOWS
Construction of flowing afterglow apparatus
[AD-A231062] N91-21855

AGRICULTURE
Experiences in assessing changes in the use of savanna ecosystems
[INPE-5187-PRE/1655] N91-21605
Spectral characteristics of agricultural crops and yield
[INPE-5125-RPE/630] N91-21619

AIR
On the dynamics of the combustion process of hydrogen-air and hydrogen-methane-air mixtures
[ESA-TT-1198] N91-21268

AIR BREATHING ENGINES
CFD for hypersonic propulsion
[NASA-TM-103791] N91-21447

AIR CARGO
Evaluation of an alternative rotorcraft cargo lowering device for the delivery of 500-lb ammunition loads
[AD-A230995] N91-21133

AIR CONDITIONING EQUIPMENT
Heat tube device
[NASA-CASE-KSC-11395-1-CU] N91-21473
AIR DATA SYSTEMS
Shuttle Entry Air Data System (SEADS) hardware development. Volume 1: Summary
[NASA-CR-166044-VOL-1] N91-21179
Shuttle Entry Air Data System (SEADS) hardware development. Volume 2: History
[NASA-CR-166044-VOL-2] N91-21180
AIR FLOW
Containerless processing in the European microgravity programme N91-21337
AIR POLLUTION
Atmospheric methane data for the period 1986-1988 from the NOAA/CMDL global cooperative flask sampling network
[PB91-129122] N91-21626
Compilation of air pollutant emission factor. Volume 1, supplement C: Stationary point and area sources, fourth edition
[PB91-125906] N91-21630
Adaptation of the Advanced Statistical Trajectory Regional Air Pollution (ASTRAP) model to the EPA VAX computer: Modifications and testing
[PB91-127720] N91-21631
Seminar on anthropogenic emissions of greenhouse gases
[DE91-009110] N91-21634
User's manual for SLAB: An atmospheric dispersion model for denser-than-air-releases
[DE91-008443] N91-21638
AIR QUALITY
Environment fact finding mission report
[PB91-130369] N91-21628
Recommended carbon dioxide and relative humidity levels for maintaining acceptable indoor air quality
[AD-A230026] N91-21717
AIR TRAFFIC CONTROL
National plan for aviation human factors, volume 1
[PB91-100339] N91-21712
National plan for aviation human factors, volume 2
[PB91-100347] N91-21713
Human factors in aviation: Terminal control area boundary conflicts
[NASA-CR-177522] N91-21714
AIR WATER INTERACTIONS
Global monthly sea surface temperature climatology
[PB91-129304] N91-21669
Current velocity and hydrographic observations in the southwestern North Atlantic Ocean: Subtropical Atlantic Climate Studies (STACS), 1989
[PB91-115535] N91-21685
Interaction of surface waves and near surface currents
[AD-A231612] N91-21694
AIRBORNE EQUIPMENT
UHF model simulation of detecting voids in a dielectric medium using HF-VHF airborne short-pulse radar
[AD-A231495] N91-21418
Intercomparison of the chemical and meteorological data generated from aircraft and shipboard sampling during GCE/CASE/WATOX
[PB91-129098] N91-21667
SOFIA: The Stratospheric Observatory For Infrared Astronomy N91-22003
AIRBORNE/SPACEBORNE COMPUTERS
Digital signal conditioning for flight test instrumentation
[NASA-TM-101739] N91-21135
Methodology development for the verification and validation of flight critical systems software, phase 1
[AD-A229932] N91-21735
AIRCRAFT APPROACH SPACING
Human factors in aviation: Terminal control area boundary conflicts
[NASA-CR-177522] N91-21714
AIRCRAFT CONFIGURATIONS
Span reduction effects on the flutter characteristics of arrow-wing supersonic transport configurations
[NASA-TP-3077] N91-21127
Advanced rotorcraft transmission program
[NASA-TM-103276] N91-21531
AIRCRAFT CONTROL
Impact of icing on Unmanned Aerial Vehicle (UAV) operations
[AD-A231191] N91-21124
AIRCRAFT DESIGN
CFD research and systems in Kawasaki Heavy Industries and its future prospects N91-21382
The CFD analysis related aerospace in Fuji Heavy Industries, Ltd. N91-21383
Status and outlook of CFD technology at Mitsubishi Heavy Industries, Nagoya N91-21384
NASA Ames aerospace systems directorate research
[NASA-TM-103844] N91-22066
AIRCRAFT ENGINES
A pressure flux-split technique for computation of inlet flow behavior N91-21068
Study of bird ingestions into small inlet area aircraft turbine engines
[DOT/FAA/CT-90/13] N91-21122
Present and future of CFD on the aero-engine development in IHI N91-21381
Application of computational fluid dynamics in high speed aeropropulsion
[NASA-TM-103780] N91-21458
AIRCRAFT GUIDANCE
Fully automatic guidance and control for rotorcraft nap-of-the-Earth flight following planned profiles. Volume 1: Real-time piloted simulation
[NASA-CR-177571-VOL-1] N91-21149
Fully automatic guidance and control for rotorcraft nap-of-the-Earth flight following planned profiles. Volume 2: Mathematical model
[NASA-CR-177571-VOL-2] N91-21150
AIRCRAFT INSTRUMENTS
Airborne heterodyne receiver for the range 600 GHz to 3,000 GHz N91-22047
AIRCRAFT LANDING
Integrated flight/propulsion control system design based on a decentralized, hierarchical approach
[NASA-TM-103678] N91-21137
AIRCRAFT MAINTENANCE
National plan for aviation human factors, volume 2
[PB91-100347] N91-21713
AIRCRAFT MANEUVERS
Predicting F-14 Air Combat Maneuvering (ACM) performance using an automated battery of cognitive/psychomotor tests
[AD-A228593] N91-21128
AIRCRAFT MODELS
Identification of the aerodynamic model of the DLR research aircraft ATTAS from flight test data
[DLR-FB-90-40] N91-21130
Acoustic and aerodynamic study of a pusher-propeller aircraft model
[NASA-TP-3040] N91-21828
AIRCRAFT NOISE
A study of rotor broadband noise mechanisms and helicopter tail rotor noise
[NASA-CR-177565] N91-21829
AIRCRAFT PILOTS
Suppression of biodynamic interference in head-tracked teleoperation
[NASA-TM-103833] N91-21134
AIRCRAFT SAFETY
Non-airborne conflicts: The causes and effects of runway transgressions
[NASA-CR-177372] N91-21121
A simple, analytical, axisymmetric microburst model for downdraft estimation
[NASA-TM-104053] N91-21132
Model rocketry hazard study
[DOT/FAA/CT-TN90/28] N91-21238
AIRCRAFT TIRES
Frictional and retarding forces on aircraft tyres. Part 5: Estimation of fluid drag forces
[ESDU-90035] N91-21537
AIRCRAFT WAKES
Velocity measurements in a turbulent trailing vortex and their application to BWI noise prediction
[NASA-CR-188083] N91-21100
Acoustic and aerodynamic study of a pusher-propeller aircraft model
[NASA-TP-3040] N91-21828
AIRFIELD SURFACE MOVEMENTS
Non-airborne conflicts: The causes and effects of runway transgressions
[NASA-CR-177372] N91-21121
AIRFOIL PROFILES
Compressible flows with periodic vortical disturbances around lifting airfoils
[NASA-TM-103742] N91-21060
AIRFOILS
Compressible flows with periodic vortical disturbances around lifting airfoils
[NASA-TM-103742] N91-21060
A finite-difference, frequency-domain numerical scheme for the solution of the linearized unsteady Euler equations N91-21067
AIRFRAMES
CFD for hypersonic propulsion
[NASA-TM-103791] N91-21447
AIRLINE OPERATIONS
A guide to ground vehicle operations on the airport
[AD-A231077] N91-21158
AIRPORTS
A guide to ground vehicle operations on the airport
[AD-A231077] N91-21158
ALCOHOLS
High octane ethers from synthesis gas-derived alcohol
[DE91-008367] N91-21325
ALGAE
A center for the study of early events in photosynthesis
[DE91-008509] N91-21698
ALGEBRA
Dynamics of local grid manipulations for internal flow problems N91-21090
The IBM RISC System/6000 and linear algebra operations
[DE91-009221] N91-21805
ALGORITHMS
Distributed Minimal Residual (DMR) method for acceleration of iterative algorithms N91-21077
Recent update of the RPLUS2D/3D codes N91-21094
Specification of the autonomous missile guidance problem for the TA11 processor. Volume 4: Processor mini-spec
[FFI-90/4005-VOL-4] N91-21145
Specification of the autonomous missile guidance problem for the TA11 processor. Volume 6: Specification mode 16, N
[FFI-90/4005-VOL-6] N91-21146
Specification of the autonomous missile guidance problem for the TA11 processor. Volume 7: Specification mode 29, N + A + T + H
[FFI-90/4005-VOL-7] N91-21147
Specification of the autonomous missile guidance problem for the TA11 processor. Volume 8: Specification mode 30, N + A + T + B
[FFI-90/4005-VOL-8] N91-21148
A time delay controller for magnetic bearings N91-21205
Microgravity vibration isolation: An optimal control law for the one-dimensional case N91-21206
Measurement and calculation of forces in a magnetic journal bearing actuator N91-21207
Critical speeds and forced response solutions for active magnetic bearing turbomachinery, part 2 N91-21210
Entry vehicle performance analysis and atmospheric guidance algorithm for precision landing on Mars
[AD-A231585] N91-21228
On the anomaly of velocity-pressure decoupling in collocated mesh solutions
[NASA-TM-103769] N91-21448
Convergence of the point vortex method for the 3-D Euler equations
[AD-A231285] N91-21479
Studies of a direct drive robot with a parallel configuration
[AD-A231265] N91-21548
A plane-sweep algorithm for exact simulation of a quasi-static mechanical system of compliantly-connected rigid bodies (extended abstract)
[AD-A231324] N91-21550
Update of PRONTO 2D and PRONTO 3D transient solid dynamics program
[DE91-009183] N91-21564
Comparison of several system identification methods for flexible structures
[NASA-TM-104046] N91-21574
GEMPAK5 user's guide, version 5.0
[NASA-TM-4260] N91-21661
On the response of the special sensor microwave/imager to the marine environment: Implications for atmospheric parameter retrievals
[NASA-CR-188032] N91-21664
Analysis of error in TOMS total ozone as a function of orbit and attitude parameters
[NASA-CR-4361] N91-21670
Gust front/wind shift detection algorithm for the terminal Doppler weather radar
[DOT/FAA/NR-91/4] N91-21671
Implementation of an oceanographic expert system: Problems, feedback, solutions
[AD-A230886] N91-21689
Analysis, preliminary design and simulation systems for control-structure interaction problems
[NASA-CR-188018] N91-21729
Implementation of a partitioned algorithm for simulation of large CSI problems
[CU-CSSC-91-4] N91-21730
Digital optical computer global interconnect algorithm study
[AD-A230282] N91-21736
A linear quadratic regulator weight selection algorithm for robust pole assignment
[AD-A230598] N91-21737
A modified SLIC material interface reconstruction algorithm for Eulerian codes
[DE91-009175] N91-21740

A monotone decreasing algorithm for the 0-1 multiknapsack dual problem
[INPE-5160-RPE/635] N91-21745
Signal parameter algorithms for trend analysis of digital data acquisition systems
[DE91-008171] N91-21749
Stability analysis of time-dependent transport algorithms
[DE91-009170] N91-21750
GRESS: A preprocessor for sensitivity studies on FORTRAN programs
[DE91-009561] N91-21751
An empirical evaluation of analytical models for parallel relational database queries
[AD-A230813] N91-21752
An object-oriented military simulation baseline for parallel simulation research
[AD-A231030] N91-21755
Rapidly convergent algorithms for nonsmooth optimization
[AD-A231110] N91-21756
Computer aided design tools and algorithms for submicron technologies
[AD-A231171] N91-21757
Graphical representation of parallel algorithmic processes
[AD-A231258] N91-21760
Excision techniques in direct sequence spread spectrum communication systems
[AD-A231290] N91-21763
Normalized convergence rates for the PSMG method
[AD-A231311] N91-21764
Feature matching for object localization in the presence of uncertainty
[AD-A231405] N91-21766
An efficient correspondence based algorithm for 2D and 3D model based recognition
[AD-A231406] N91-21767
Continuation and bifurcation investigations in constrained optimization
[AD-A231639] N91-21769
Hypercube clock synchronization
[DE91-009222] N91-21774
On the massively parallel solution of the assignment problem
[AD-A230847] N91-21775
The simplification of fuzzy control algorithm and hardware implementation N91-21781
Self-organization and clustering algorithms N91-21783
Solution of inverse problem of fuzzy relational equation by using perceptron model N91-21786
Asymptotic integration algorithms for nonhomogeneous, nonlinear, first order, ordinary differential equations
[NASA-TM-103793] N91-21797
Functional specifications for mathematical computations
[DE91-006002] N91-21803
The IBM RISC System/6000 and linear algebra operations
[DE91-009221] N91-21805
Geographic information systems: A primer
[AD-A231465] N91-21974

ALIGNMENT
Laser test for spindle parallelism
[DE91-009716] N91-21518
Mechanical strain isolator mount
[NASA-CASE-LAR-13580-1] N91-21541
Alignment positioning mechanism
[NASA-CASE-MSC-21502-1] N91-21543
The series Bi2Sr2Ca(n-1) Cu(n)O(2n+4) (1 less than or equal to n less than or equal to 5): Phase stability and superconducting properties
[NASA-TM-103749] N91-21910

ALLOCATIONS
NASA space shuttle/space station N91-21979
Mission to Planet Earth N91-21980
Aeronautics and space technology N91-21981
Commercial space programs N91-21983

ALPHA PARTICLES
Corrections to the participant-spectator model of high-energy alpha-particle fragmentation
[NASA-TM-4262] N91-21860
Some observations concerning alpha instabilities and driven tokamak reactors
[DE91-008628] N91-21898

ALPHANUMERIC CHARACTERS
Source header list. Volume 1: A through K
[AD-A231000] N91-21971
Source header list. Volume 2: L through Z
[AD-A231001] N91-21972

ALTERNATING CURRENT
Spatial variations in ac susceptibility and microstructure for the YBa2Cu3O(7-x) superconductor and their correlation with room-temperature ultrasonic measurements
[NASA-TM-103787] N91-21553

ALUMINUM
Acoustic emission-fracture strength relations for Al/Gr composites
[DE91-009106] N91-21251
A study of the inhibition of pitting of aluminum by chromate
[DE91-006915] N91-21294
Magnetic quasicrystals
[AD-A231264] N91-21924

ALUMINUM ALLOYS
CO2 induced inhibition of the localized corrosion of aluminum, Al-0.5 percent Cu, and Al-2 percent Cu in dilute HF solution
[DE91-005312] N91-21292
XANES (X ray Absorption Near Edge Structure) investigation of cerium as an inhibitor for Al alloys
[DE91-005542] N91-21293
Controlling fundamentals in high-energy high-rate pulsed power materials processing of powdered tungsten, titanium aluminides, and copper-graphite composites
[AD-A230900] N91-21298
The mechanical property data base from an Air Force/industry cooperative test program on advanced aluminum alloys (8090 extrusion)
[AD-A230903] N91-21299
Environmentally-induced passivity of aluminum alloys and aluminum metal matrix composites
[AD-A231350] N91-21301

ALUMINUM COATINGS
Material properties of silicon carbide fibers with continuously applied sol-gel alumina coatings
[AD-A230825] N91-21256

ALUMINUM GALLIUM ARSENIDES
Subthreshold I-V characteristics of AlGaAs/GaAs MODFETs: The role of unintentional acceptors
[AD-A230110] N91-21904

ALUMINUM NITRIDES
Integrated synthesis and post processing of silicon carbide and aluminum nitride
[AD-A230810] N91-21317

ALUMINUM OXIDES
Material properties of silicon carbide fibers with continuously applied sol-gel alumina coatings
[AD-A230825] N91-21256

AMINO ACIDS
High-performance capillary electrophoresis of histones
[DE91-008585] N91-21275
A center for the study of early events in photosynthesis
[DE91-008509] N91-21698

AMMONIA
Control of catalytic hydrotreating selectivity with ammonia
[DE91-008405] N91-21272

AMMONIUM NITRATES
Elastomer compatibility with liquid propellant at elevated temperature
[AD-A230973] N91-21327

AMORPHOUS MATERIALS
Modified chemical vapor deposition of gradient index lenses
[AD-A230989] N91-21281
Observation of the photorefractive effect in a polymer
[AD-A231339] N91-21322
Containerless processing of amorphous ceramics N91-21367

AMORPHOUS SILICON
Theory of structure and properties of hydrogenated amorphous silicon
[DE91-009353] N91-21315

AMPLIFICATION
Amplification of femtosecond pulses using a N2 pump laser
[DE91-008413] N91-21513
Statistical fluctuations in lasers
[DE91-009540] N91-21517

AMPLIFIER DESIGN
Estimating power amplifier large signal gain
[AD-A230823] N91-21437

ANAEROBES
Comparison of the activity of subsurface and surface microorganisms and their anaerobic transformation of heterocyclic compounds
[DE91-008839] N91-21703

ANALOG DATA
Test results of a 90 MHz integrated circuit sixteen channel analog pipeline for SSC detector calorimetry
[DE91-009773] N91-21436
Physical property measurements on analog granites related to the joint verification experiment
[AD-A230571] N91-21650

ANALYSIS (MATHEMATICS)
Transverse klystron
[AD-A231586] N91-21444

ANALYTICAL CHEMISTRY
Analytical chemistry laboratory
[DE91-008986] N91-21266

ANECHOIC CHAMBERS
Analysis and testing of a bistatic radar cross section measurement capability for the AFIT anechoic chamber
[AD-A230609] N91-21401

ANGLE OF ATTACK
Computer program for the calculation of normal force and pitching moment of forebody-cylinder combinations at angles of attack up to 90 degrees and Mach numbers up to 5, including effects of conical boat-tailing
[ESDU-90034] N91-21102
Coning motion of slender bodies at high angles of attack
[NAL-TR-1059] N91-21111
Investigation of nose bluntness and angle of attack effects on slender bodies in viscous hypertension flows
[NASA-CR-188153] N91-21117

ANGLES (GEOMETRY)
Angle measurements with the laser gyro GG 1342
[ESA-TT-1212] N91-21490

ANGULAR MOMENTUM
Transport in auxiliary-heated, hot-ion H-mode and L-mode discharges in the DIII-D tokamak
[DE91-008924] N91-21887

ANGULAR VELOCITY
Passive dynamic controllers for nonlinear mechanical systems
[NASA-TM-104047] N91-21573

ANIMALS
Science, medicine and animals
[ISBN-0-309-04439-1] N91-21697

ANISOTROPY
A method for the geometrically nonlinear analysis of compressively loaded prismatic composite structures
[NASA-CR-184846] N91-21561
RELICT 2 project: Scientific program and structure N91-21998
A millimeter and submillimeter balloon telescope for measurements of diffuse radiation N91-22040
The TIR project: A balloon telescope for the measurement of CBR anisotropies N91-22041
A high throughput, multiband photometer for the TIR project N91-22042

ANNEALING
An investigation of Si-SiO2 interface charges in thermally oxidated (100), (110), (111), (511) silicon
[AD-A231244] N91-21923

ANNIHILATION REACTIONS
Molecular beam epitaxial growth and electronic properties of GaP-on-Si (211) heterostructures, and of related systems
[AD-A231125] N91-21921

ANNUAL VARIATIONS
Dynamics of vegetation and soils of oak/saw palmetto scrub after fire: Observations from permanent transects
[NASA-TM-103817] N91-21635
Global monthly sea surface temperature climatology
[PB91-129304] N91-21669
Spectral analysis of annual sunspot series: An update
[INPE-5207-PRE/1669] N91-22060

ANNULAR NOZZLES
Experimental and theoretical studies of vertical annular liquid jets
[DE91-008042] N91-21461

ANOMALIES
Flight motor set 360T010 (STS-31R). Volume 1: System overview
[NASA-CR-184104] N91-21231
On the anomaly of velocity-pressure decoupling in collocated mesh solutions
[NASA-TM-103769] N91-21448
The study of plasma clouds around large active space structures
[AD-A230634] N91-21881

ANTARCTIC REGIONS
Comparative study of VLF signals in the sub-Antarctic region
[INPE-5165-TDL/426] N91-21406
Submillimeter astronomy from the Antarctic plateau N91-22035
The OASI observatory in Antarctica N91-22036

ANTENNA ARRAYS
AEDC focal plane array test capability
[AD-A230846] N91-21408
Analysis and design of antenna structures: Diakoptic theory and the moment method
[AD-A230838] N91-21438

ANTENNA DESIGN
A new fabrication method for precision antenna reflectors for space flight and ground test
[NASA-TP-3078] N91-21185
L-band antenna array with integrated phase shifters
[ESA-TT-1215] N91-21405
Analysis and design of antenna structures: Diakoptic theory and the moment method
[AD-A230838] N91-21438
System and method for measuring ocean surface currents at locations remote from land masses using synthetic aperture radar
[NASA-CASE-NPO-17937-1-CU] N91-21621
ANTENNA RADIATION PATTERNS
Extended database of microwave common carrier antenna gain patterns
[PB91-119206] N91-21398
Analysis and design of antenna structures: Diakoptic theory and the moment method
[AD-A230838] N91-21438
ANTENNAS
Noise factor and antenna gains in the signal/noise equation for over-the-horizon radar
[AD-A231203] N91-21416
ANTIMISSILE DEFENSE
Notes on space, satellites, and survivability
[DE91-009229] N91-21226
Efficient approaches for report/cluster correlation in multitarget tracking systems
[AD-A231589] N91-21421
Geomagnetic model investigations for 1980 - 1989: A model for strategic defense initiative particle beam experiments and a study in the effects of data types and observatory bias solutions
[NASA-TM-104541] N91-21654
Requirements for progressive strategic defenses
[DE91-008997] N91-21812
Near-term boost-phase defense sensitivities
[DE91-008999] N91-21813
Interaction of strategic defenses with crisis stability
[DE91-009002] N91-21814
Strategic defense requirements for progressive applications
[DE91-009045] N91-21816
Threat modernization in the near term
[DE91-009228] N91-21817
Discrimination options in the near term
[DE91-009000] N91-21818
Background issues for defensive interceptors
[DE91-009219] N91-21819
ANTIREFLECTION COATINGS
Thermal transport studies of optical coatings, interfaces and surfaces by thermal diffusion-wave interferometry
[AD-A231607] N91-21879
ANVILS
Pressure dependence of deep centers by capacitance spectroscopies inside the diamond anvil cell
[DE91-008927] N91-21906
APERTURES
Numerical approximations of the Green's functions for a theoretical model of an aperture fed stacked-patch microstrip antenna
[AD-A230702] N91-21429
Serrated circular apertures: Optical Fourier transforms and fractal analysis
[AD-A230834] N91-21874
APPLICATION SPECIFIC INTEGRATED CIRCUITS
A demonstration of CMOS VLSI circuit prototyping in support of the site facility using the 1.2 micron standard cell library developed by National Security Agency
[NASA-CR-188014] N91-21426
APPLICATIONS PROGRAMS (COMPUTERS)
Computer program for the calculation of normal force and pitching moment of forebody-cylinder combinations at angles of attack up to 90 degrees and Mach numbers up to 5, including effects of conical boat-tailing
[ESDU-90034] N91-21102
OD system for the first Brazilian satellite-software testing, analysis, and assessment
[INPE-5158-PRE/1637] N91-21169
Delamination and free edge stresses in laminated plates subjected to constant uniaxial strain (computer program)
[ESDU-90021] N91-21253
The fast Hartley transform
[AD-A230370] N91-21400
Study of asymmetrical electric discharges using particle simulation
[INPE-5198-TDL/427] N91-21432
GEMPAK5 user's guide, version 5.0
[NASA-TM-4260] N91-21661
GEMPAK5. Part 1: GEMPAK5 programmer's guide, version 5.0
[NASA-TM-4261-PT-1] N91-21662
GEMPAK5. Part 2: GEMPLT programmer's guide, version 5.0
[NASA-TM-4261-PT-2] N91-21663
A toolkit for designing user interfaces
[AD-A231558] N91-21723
Methodology development for the verification and validation of flight critical systems software, phase 1
[AD-A229932] N91-21735
GRESS: A preprocessor for sensitivity studies on FORTRAN programs
[DE91-009561] N91-21751
APPROPRIATIONS
Space station: NASA's search for design, cost, and schedule stability continues
[GAO/NSIAD-91-125] N91-21187
NASA authorizations
[S-HRG-101-981] N91-21977
NASA overview N91-21978
NASA space shuttle/space station N91-21979
Mission to Planet Earth N91-21980
Aeronautics and space technology N91-21981
Space science and applications N91-21982
Commercial space programs N91-21983
APPROXIMATION
Critical speeds and forced response solutions for active magnetic bearing turbomachinery, part 1 N91-21209
Numerical approximations of the Green's functions for a theoretical model of an aperture fed stacked-patch microstrip antenna
[AD-A230702] N91-21429
A method for the geometrically nonlinear analysis of compressively loaded prismatic composite structures
[NASA-CR-184846] N91-21561
Solution of inverse problem of fuzzy relational equation by using perceptron model N91-21786
Numerical analysis methods. Volume 3: Autocorrection methods
[INPE-5196-MD/45] N91-21807
Optimal Hankel-norm approximation and rational function models using impulse response data
[AD-A231317] N91-21839
AQUATIC PLANTS
Temporal variation of areas occupied by aquatic macrophytes in the Tucurui reservoir through Landsat/TM data
[INPE-5174-PRE/1643] N91-21607
AQUEOUS SOLUTIONS
Ex-situ and in-situ ellipsometric studies of the thermal oxide on InP
[AD-A231095] N91-21283
ARC DISCHARGES
Broad-beam, high current, metal ion implantation facility
[DE91-009329] N91-21291
Kapton wire arc track testing: Per test procedure KWATT BB01
[NASA-CR-185642] N91-21427
ARC HEATING
Nonintrusive nitric oxide density measurements in the NASA Langley arc-heated scramjet engine test facility
[AD-A231260] N91-21142
ARC LAMPS
Toward high brightness, multi-kilowatt solid state lasers
[DE91-008990] N91-21504
ARCHITECTURE
Requirements and trade-off studies in satellite mechanical architecture
[INPE-5186-PRE/1654] N91-21219
ARCHITECTURE (COMPUTERS)
Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics: Prospects of Computational Fluid Dynamics and Super Computers in Aerospace Science and Technology
[NAL-SP-13] N91-21379
Computer requirements for further CFD development N91-21380
The CFD analysis related aerospace in Fuji Heavy Industries, Ltd. N91-21383
Parallelization techniques for a supercomputer with hierarchical memory architecture N91-21386
Implementation of FFT and pulse compression routines on the SPT frequency domain array processor
[AD-A231320] N91-21443
Update of PRONTO 2D and PRONTO 3D transient solid dynamics program
[DE91-009183] N91-21564
VM-CMS tutorial
[DE91-009444] N91-21725
Digital optical computer global interconnect algorithm study
[AD-A230282] N91-21736
Automated computer software development standards enforcement
[DE91-007328] N91-21748
GRESS: A preprocessor for sensitivity studies on FORTRAN programs
[DE91-009561] N91-21751
VHSIC Hardware Description Language (VHDL) benchmark suite
[AD-A231276] N91-21761
Computing with neural networks: A comparison of the multi-layer perceptron and the hierarchical pattern recognition network for classification problems
[AD-A231584] N91-21768
Continuation and bifurcation investigations in constrained optimization
[AD-A231639] N91-21769
Tools for monitoring and controlling distributed applications
[NASA-CR-188034] N91-21770
A heterogeneous parallel programming capability
[AD-A229710] N91-21772
Fuzzy associative memories N91-21779
Experiments on neural network architectures for fuzzy logic N91-21787
Using fuzzy logic to integrate neural networks and knowledge-based systems N91-21788
The IBM RISC System/6000 and linear algebra operations
[DE91-009221] N91-21805
ARGON
A study of helium. Argon: Ethane gas mixtures used in drift chambers for large acceptance spectrometers in high magnetic fields
[AD-A231209] N91-21284
ARID LANDS
Discrimination of lithological units in the lower Valley of the Curaca River (Bahia), through enhancement of digital processing of MSS-LANDSAT-3 data
[INPE-5120-RPE/627] N91-21613
ARMED FORCES (UNITED STATES)
Top quality management, reliability, and maintainability: Institutional goals with built in barriers
[AD-A230134] N91-21552
ARMOR
A comparison of calculational results with experimental data for long rod projectiles
[DE91-009006] N91-21536
ARRAYS
Stability considerations for magnetic suspension systems using electromagnets mounted in a planar array N91-21202
Implementation of FFT and pulse compression routines on the SPT frequency domain array processor
[AD-A231320] N91-21443
Intelligent array system
[AD-A231107] N91-21792
SCUBA: A submillimetre camera N91-22044
The mm and sub-mm wave planar antenna arrays for SIS detectors N91-22046
ARROW WINGS
Span reduction effects on the flutter characteristics of arrow-wing supersonic transport configurations
[NASA-TP-3077] N91-21127
ARTIFICIAL INTELLIGENCE
Applications of artificial neural nets in structural mechanics
[NASA-TM-102420] N91-21559
An endorsement-based approach to student modeling for planner-controlled intelligent tutoring systems
[NASA-CR-188177] N91-21739
Computing with neural networks: A comparison of the multi-layer perceptron and the hierarchical pattern recognition network for classification problems
[AD-A231584] N91-21768
Designing a training tool for imaging mental models
[NASA-CR-187891] N91-21776
Learning control of inverted pendulum system by neural network driven fuzzy reasoning: The learning function of NN-driven fuzzy reasoning under changes of reasoning environment N91-21785
Using artificial intelligence to aid in the development of causal models
[AD-A231273] N91-21794
ARTIFICIAL SATELLITES
OD system for the first Brazilian satellite-software testing, analysis, and assessment
[INPE-5158-PRE/1637] N91-21169
Notes on space, satellites, and survivability
[DE91-009229] N91-21226
A perturbation solution of the main problem in artificial satellite theory
[AD-A231560] N91-21227
Tactical Environmental Support System (TESS(3)) satellite cloud analyses
[AD-A231247] N91-21681
ASCENT
Atmospheric environment for space shuttle (STS-38) launch
[NASA-TM-103530] N91-21633

ASPECT RATIO
Vortex bursting over a unit area aspect ratio delta wing using vortex paneling methods
[AD-A231028] N91-21119
ASSIMILATION
Data assimilation and wind-stress error correction in a forced tropical ocean model N91-21687
ASTROGRAPHY
Submillimeter observations with the Kuiper Airborne Observatory N91-21987
Early results from the Cosmic Background Explorer (COBE) N91-21988
ASTRONAUTS
Ventilation loss and pressurization in the NASA launch/entry suit: Potential for heat stress
[NASA-CR-188075] N91-21719
Life sciences on-line: A study in hypermedia application N91-21943
ASTRONOMICAL CATALOGS
A search for stellar occultations by Uranus, Neptune, Pluto, and their satellites: 1990-1999
[NASA-CR-188146] N91-22053
ASTRONOMICAL MAPS
Early results from the Cosmic Background Explorer (COBE) N91-21988
Submillimeter astronomy and low mass star formation N91-22012
ASTRONOMICAL MODELS
Interstellar chemistry and submillimetre astronomy N91-22021
ASTRONOMICAL OBSERVATORIES
SOFIA: The Stratospheric Observatory For Infrared Astronomy N91-22003
The Swedish-ESO Submillimeter Telescope (SEST) N91-22008
The James Clerk Maxwell telescope N91-22031
The Caltech Submillimeter Observatory N91-22032
Submillimeter astronomy from the Antarctic plateau N91-22035
The OASI observatory in Antarctica N91-22036
The University of Tokyo-Norbeyama Radio Observatory submillimeter survey telescope N91-22051
ASTRONOMICAL PHOTOGRAPHY
LDR: A submillimeter great observatory N91-22018
ASTRONOMICAL SATELLITES
The submillimeter wave astronomy satellite N91-22025
ASTRONOMICAL SPECTROSCOPY
Submillimeter observations with the Kuiper Airborne Observatory N91-21987
Submillimeter observations of extragalactic objects in the wavelength range 50 microns to 1 mm N91-21994
ASTRONOMY
From ground-based to space-borne sub-mm astronomy
[ESA-SP-314] N91-21986
Submillimetre photometry of comets N91-22052
ASTROPHYSICS
Space research in Norway N91-21167
From ground-based to space-borne sub-mm astronomy
[ESA-SP-314] N91-21986
The microwave background: Its smoothness and frequency distribution as an astrophysical product N91-21992
The Smithsonian Astrophysical Observatory submillimeter wave telescope array N91-22009
ASYMMETRY
Study of asymmetrical electric discharges using particle simulation
[INPE-5198-TDL/427] N91-21432
ASYMPTOTIC GIANT BRANCH STARS
Late-type stars at far-infrared and sub-millimeter wavelengths N91-22006
ASYMPTOTIC METHODS
Layer tracking asymptotics and domain decomposition
[DE91-008593] N91-21462
Asymptotic integration algorithms for nonhomogeneous, nonlinear, first order, ordinary differential equations
[NASA-TM-103793] N91-21797
ATLANTIC OCEAN
Experiment on rapidly intensifying cyclones over the Atlantic
[AD-A231377] N91-21682
Current velocity and hydrographic observations in the southwestern North Atlantic Ocean: Subtropical Atlantic Climate Studies (STACS), 1989
[PB91-115535] N91-21685
ATLAS CENTAUR LAUNCH VEHICLE
Dynamic response of a hammerhead launch vehicle wind-tunnel model
[NASA-TM-104050] N91-21177
ATMOSPHERIC BOUNDARY LAYER
Estimations of ABL fluxes and other turbulence parameters from Doppler lidar data
[NASA-CR-188062] N91-21648
ATMOSPHERIC CHEMISTRY
Volcanism-Climate Interactions
[NASA-CP-10062] N91-21641
Intercomparison of the chemical and meteorological data generated from aircraft and shipboard sampling during GCE/CASE/WATOX
[PB91-129098] N91-21667
ATMOSPHERIC CIRCULATION
Using climate model output to assess the impacts of climate change on water resources
[DE91-004542] N91-21637
User's manual for SLAB: An atmospheric dispersion model for denser-than-air-releases
[DE91-008443] N91-21638
Climatic impact of volcanic eruptions N91-21643
ONR tropical cyclone motion research initiative: Field experiment summary
[AD-A231152] N91-21679
ATMOSPHERIC COMPOSITION
Atmospheric methane data for the period 1986-1988 from the NOAA/CMDL global cooperative flask sampling network
[PB91-129122] N91-21626
ATMOSPHERIC EFFECTS
Report of the panel on volcanology, section 4 N91-21593
Historical evidence for a connection between volcanic eruptions and climate change N91-21642
ATMOSPHERIC ENTRY
Parametric entry corridors for lunar/Mars aerocapture missions
[NASA-TM-102178] N91-21168
Shuttle Entry Air Data System (SEADS) hardware development. Volume 1: Summary
[NASA-CR-166044-VOL-1] N91-21179
Shuttle Entry Air Data System (SEADS) hardware development. Volume 2: History
[NASA-CR-166044-VOL-2] N91-21180
Estimates of thermochemical relaxation lengths behind normal shock waves relevant to manned lunar and Mars return missions, the aeroassist flight experiment, and Mars entry
[NASA-TM-102879] N91-21471
ATMOSPHERIC GENERAL CIRCULATION MODELS
Global monthly sea surface temperature climatology
[PB91-129304] N91-21669
Current velocity and hydrographic observations in the southwestern North Atlantic Ocean: Subtropical Atlantic Climate Studies (STACS), 1989
[PB91-115535] N91-21685
ATMOSPHERIC HEATING
Cloud and ocean effects on global greenhouse warming
[DE91-008842] N91-21639
ATMOSPHERIC MODELS
Using the USU ionospheric model to predict radio propagation through a simulated ionosphere
[AD-A231599] N91-21423
Using climate model output to assess the impacts of climate change on water resources
[DE91-004542] N91-21637
User's manual for SLAB: An atmospheric dispersion model for denser-than-air-releases
[DE91-008443] N91-21638
Cloud and ocean effects on global greenhouse warming
[DE91-008842] N91-21639
Volcanism-Climate Interactions
[NASA-CP-10062] N91-21641
Volcanic effects on climate N91-21646
On the response of the special sensor microwave/imager to the marine environment: Implications for atmospheric parameter retrievals
[NASA-CR-188032] N91-21664
ATMOSPHERIC MOISTURE
Wet atmospheric generation apparatus
[NASA-CASE-MFS-28177-1] N91-21496
A search for episodic increases in upper atmospheric water vapor as evidence of an extraterrestrial source
[AD-A231598] N91-21660
Satellite-derived moisture-bogusing profiles for the Northwest Pacific Ocean
[AD-A231058] N91-21690
ATMOSPHERIC PHYSICS
Large eddy simulation: Where do we stand
[AD-A230835] N91-21657
National Geophysical Data Center: Programs and services (25th anniversary 1965-1990)
[PB91-123356] N91-21960
MOSES: A proposed Swedish submillimeter satellite for combined astronomical and atmospheric observations N91-22050
ATMOSPHERIC PRESSURE
Satellite-derived moisture-bogusing profiles for the Northwest Pacific Ocean
[AD-A231058] N91-21690
ATMOSPHERIC RADIATION
Volcanic aerosols: Chemistry, evolution, and effects N91-21645
ATMOSPHERIC SOUNDING
Case study analysis of clustering applied to VAS measurements
[PB91-127829] N91-21666
ATMOSPHERIC TURBULENCE
Estimations of ABL fluxes and other turbulence parameters from Doppler lidar data
[NASA-CR-188062] N91-21648
ATOMIC CLOCKS
Quartz crystal resonators and oscillators for frequency control and timing applications: A tutorial, revision 4
[AD-A231604] N91-21445
Navigation Experiment NAVEX: Measurement and performance of the spaceborne clocks
[ESA-TT-1209] N91-21823
ATOMIC ENERGY LEVELS
Photoelectron spectroscopy of Si2
[AD-A230911] N91-21853
ATOMIC STRUCTURE
Contributions of conformational and structural defects to the hyper-polarizabilities of polymers
[DE91-009042] N91-21313
Theory of structure and properties of hydrogenated amorphous silicon
[DE91-009353] N91-21315
Artifact diamond characterization
[AD-A231555] N91-21323
Theoretical studies of highly energetic CBES materials
[AD-A231340] N91-21329
Theoretical investigation leading to energy storage in atomic and molecular systems
[AD-A231275] N91-21858
Beam line and associated work
[AD-A231243] N91-21867
Interplay between local environment effect and electronic structure properties in close packed structures
[DE91-008506] N91-21915
An investigation of Si-SiO2 interface charges in thermally oxidated (100), (110), (111), (511) silicon
[AD-A231244] N91-21923
Magnetic quasicrystals
[AD-A231264] N91-21924
Host materials for 4d(sup N) and 5d(sup N) transition-metal ions
[AD-A231606] N91-21933
ATOMIZING
Growth and characterization of thin films of Y2O3, La2O3 and La2CuO4
[AD-A231046] N91-21919
ATTENUATORS
Determination of the flight hardware configuration of an energy absorbing attenuator for the proposed Space Station crew and equipment translation aid cart
[NASA-TP-3084] N91-21556
ATTITUDE (INCLINATION)
Analysis of error in TOMS total ozone as a function of orbit and attitude parameters
[NASA-CR-4361] N91-21670
ATTITUDE CONTROL
The spacecraft control laboratory experiment optical attitude measurement system
[NASA-TM-102624] N91-21186
Attitude control simulation of the data collecting satellite: SCD2
[INPE-5159-PRE/1638] N91-21218
Power optimal single-axis articulating strategies
[NASA-CR-187510] N91-21581
AURORAL ZONES
The effects of magnetic storm phases on F-layer irregularities from auroral to equatorial latitudes
[AD-A231373] N91-21658
AURORAS
Quasilinear simulation of auroral kilometric radiation by a relativistic Fokker-Planck code
[DE91-009736] N91-21656
AUSTENITE
Formation of controlled adiabatic shear bands in AISI 4340 high strength steel
[AD-A230999] N91-21300
AUSTENITIC STAINLESS STEELS
Measurement of residual stresses by x ray diffraction near simulated heat affected zones in austenitic stainless steels
[DE91-008874] N91-21289
AUTOCORRELATION
Numerical analysis methods. Volume 3: Autocorrection methods
[INPE-5196-MD/45] N91-21807
AUTOMATIC FLIGHT CONTROL
Fully automatic guidance and control for rotorcraft nap-of-the-Earth flight following planned profiles. Volume 1: Real-time piloted simulation
[NASA-CR-177571-VOL-1] N91-21149

Fully automatic guidance and control for rotorcraft nap-of-the-Earth flight following planned profiles. Volume 2: Mathematical model
[NASA-CR-177571-VOL-2] N91-21150

AUTOMATIC PILOTS
Fully automatic guidance and control for rotorcraft nap-of-the-Earth flight following planned profiles. Volume 1: Real-time piloted simulation
[NASA-CR-177571-VOL-1] N91-21149

AUTOMOBILE ENGINES
Development of a gas engine-driven chiller
[PB91-130237] N91-21389

AUTOMOBILE FUELS
Use of natural gas and liquefied petroleum gas in heavy-duty engines
[DE91-752990] N91-21546

AUTONOMOUS NAVIGATION
Fully automatic guidance and control for rotorcraft nap-of-the-Earth flight following planned profiles. Volume 1: Real-time piloted simulation
[NASA-CR-177571-VOL-1] N91-21149
Fully automatic guidance and control for rotorcraft nap-of-the-Earth flight following planned profiles. Volume 2: Mathematical model
[NASA-CR-177571-VOL-2] N91-21150

AUTONOMY
Specification of the autonomous missile guidance problem for the TA11 processor. Volume 4: Processor mini-spec
[FFI-90/4005-VOL-4] N91-21145
Specification of the autonomous missile guidance problem for the TA11 processor. Volume 6: Specification mode 16, N
[FFI-90/4005-VOL-6] N91-21146
Specification of the autonomous missile guidance problem for the TA11 processor. Volume 7: Specification mode 29, N + A + T + H
[FFI-90/4005-VOL-7] N91-21147
Specification of the autonomous missile guidance problem for the TA11 processor. Volume 8: Specification mode 30, N + A + T + B
[FFI-90/4005-VOL-8] N91-21148

AVIATION PSYCHOLOGY
National plan for aviation human factors, volume 1
[PB91-100339] N91-21712
National plan for aviation human factors, volume 2
[PB91-100347] N91-21713

AVIONICS
Embedded computers: Navy's approach to developing patrol aircraft avionics system too risky
[AD-A230868] N91-21136

AXIAL FLOW
A modal aeroelastic analysis scheme for turbomachinery blading
[NASA-CR-187089] N91-21138
Frequency response of a supported thermocouple wire: Effects of axial conduction
[NASA-CR-188101] N91-21489
Slant hot-wire inclination measurement using dual laser beams
[NAL-TR-1078] N91-21491

AXIAL FLOW TURBINES
Computational study of three dimensional viscous flow through a turbine cascade using a multi-domain spectral technique N91-21066

AXISYMMETRIC FLOW
On the nonlinear stability of a high-speed, axisymmetric boundary layer
[NASA-CR-187538] N91-21099

AZIDES (INORGANIC)
Theoretical studies of highly energetic CBES materials
[AD-A231340] N91-21329

B

BACKGROUND NOISE
The microwave background: Its smoothness and frequency distribution as an astrophysical product N91-21992
RELICT 2 project: Scientific program and structure N91-21998

BACKGROUND RADIATION
Background issues for defensive interceptors
[DE91-009219] N91-21819
Early COBE results and superconducting cosmic strings N91-21989
The microwave background: Its smoothness and frequency distribution as an astrophysical product N91-21992
Extragalactic source counts, confusion limits and contributions to the background radiation in the sub-mm N91-21995
Japanese space programmes of IR and sub-mm astronomy N91-21997
RELICT 2 project: Scientific program and structure N91-21998
Submillimeter observations of interstellar dust N91-22028
The OASI observatory in Antarctica N91-22036
A millimeter and submillimeter balloon telescope for measurements of diffuse radiation N91-22040
The TIR project: A balloon telescope for the measurement of CBR anisotropies N91-22041
A high throughput, multiband photometer for the TIR project N91-22042

BACKWARD FACING STEPS
Pressure algorithm for elliptic flow calculations with the PDF method N91-21081
Turbulent separated flow past a backward-facing step: A critical evaluation of two-equation turbulence models
[NASA-CR-187532] N91-21451

BACTERIA
In vitro photoreactivation of transforming DNA of Bacillus subtilis spores after irradiation by ultraviolet light
[ESA-TT-1210] N91-21699

BALANCE
Magnetic suspension and balance system advanced study, 1989 design N91-21197

BALL BEARINGS
Evaluation of bearing configurations using the single bearing tester in liquid nitrogen
[NASA-TM-103527] N91-21532
Fully articulated four-point-bend loading fixture
[NASA-CASE-LEW-14776-1] N91-21540

BALLOON-BORNE INSTRUMENTS
From ground-based to space-borne sub-mm astronomy
[ESA-SP-314] N91-21986
Sub-millimetric cosmology: From ground based to space observations N91-21991
Large-scale (CII) 158 micron emission of the Galaxy observed by a balloon-borne telescope N91-22004
PRONAOS N91-22020
An active telescope for the sub-millimetre PRONAOS balloon-borne project N91-22038
A millimeter and submillimeter balloon telescope for measurements of diffuse radiation N91-22040
The TIR project: A balloon telescope for the measurement of CBR anisotropies N91-22041
A flexible hybrid spectrometer for balloon borne and ground based (sub)millimeter wavelength astronomy N91-22043

BARIUM OXIDES
Structural characterization of the Ag/YBa2Cu3O(7-x) interface
[DE91-009112] N91-21907
Magnetic field induced broadening of the resistive transition in epitaxial films of YBa2Cu3O7 and Y2Ba4Cu8O16
[DE91-009825] N91-21916

BATCH PROCESSING
Process integration: Process change and batch processes
[ESDU-90033] N91-21390

BAYES THEOREM
Bayesian analysis of constrained parameter and truncated data problems
[AD-A231080] N91-21810
Image recovery by simulated annealing
[AD-A230655] N91-21869

BEACONS
GaAs monolithic RF modules for SARSAT distress beacons
[NASA-TM-104338] N91-21184

BEAM CURRENTS
Broad-beam, high current, metal ion implantation facility
[DE91-009329] N91-21291
Survey on electron beam processing technologies
[DE91-759126] N91-21866

BEAM INTERACTIONS
Diffusive transport enhancement by isolated resonances and distribution tails growth in hadronic beams
[DE91-006379] N91-21864

BEAMS (RADIATION)
Specification for a standard radar sea clutter model
[AD-A230848] N91-21409
High resolution beamforming on large aperture vertical line arrays: Processing synthetic data
[AD-A231054] N91-21415

BEAMS (SUPPORTS)
A fully Galerkin method for the recovery of stiffness and damping parameters in Euler-Bernoulli beam models
[NASA-CR-187517] N91-21796

BEARINGS
Five degree-of-freedom control of an ultra-precision magnetically-suspended linear bearing N91-21196
Analysis of rolling contact spall life in 440 C steel bearing rims
[NASA-CR-184101] N91-21526

BEND TESTS
A simple test for thermomechanical evaluation of ceramic fibers
[NASA-TM-103767] N91-21309
Fully articulated four-point-bend loading fixture
[NASA-CASE-LEW-14776-1] N91-21540

BENDING
Fracture toughness of unidirectional fiber reinforced ceramic composites in Mode 2 utilizing laser interferometry
[AD-A231027] N91-21258

BENDING VIBRATION
Dynamic response of a hammerhead launch vehicle wind-tunnel model
[NASA-TM-104050] N91-21177

BERNOULLI THEOREM
A fully Galerkin method for the recovery of stiffness and damping parameters in Euler-Bernoulli beam models
[NASA-CR-187517] N91-21796

BERYLLIUM
Comparison of beryllium and graphite first-walls in JET
[DE91-005489] N91-21884
Study of relativistic electrons at channeling in a beryllium thick crystals
[DE91-619859] N91-21909

BERYLLIUM 9
Colorado School of Mines fusion gamma ray diagnostic project
[DE91-009259] N91-21889

BETA PARTICLES
Radiation dose calculations with the Monte Carlo method
[DE91-008582] N91-21841

BETATRONS
Studies of synchrotron radiation emission from the NRL modified betatron accelerator
[AD-A231346] N91-21868

BIAS
Magnetic bearings with zero bias N91-21194
Magnetic bearings for a spaceflight optical disk recorder N91-21195

BIBLIOGRAPHIES
Bibliography on the international network of biosphere reserves
[PB90-215518] N91-21600
An annotated bibliography of hypobaric decompression sickness research conducted at the Crew Technology Division, USAF School of Aerospace Medicine, Brooks AFB, Texas from 1983 to 1988
[AD-A231355] N91-21710
National Geophysical Data Center: Programs and services (25th anniversary 1965-1990)
[PB91-123356] N91-21960
Identification of information needs in a research institute
[INPE-5154-TDL/425] N91-21967

BICRYSTALS
Grain boundaries
[DE91-007932] N91-21905

BIG BANG COSMOLOGY
Early results from the Cosmic Background Explorer (COBE) N91-21988

BIODYNAMICS
Suppression of biodynamic interference in head-tracked teleoperation
[NASA-TM-103833] N91-21134

BIOLOGICAL EFFECTS
ELF communications system, ecological monitoring program: Summary of 1989 progress
[AD-A231497] N91-21419
Rotating bio-reactor cell culture apparatus
[NASA-CASE-MSC-21293-1] N91-21700
Specificity of mutation induced by ionizing radiation and oxidizing free radicals
[DE91-008838] N91-21702

BIOLOGICAL EVOLUTION
A center for the study of early events in photosynthesis
[DE91-008509] N91-21698

BIOMASS
Experiences in assessing changes in the use of savanna ecosystems
[INPE-5187-PRE/1655] N91-21605

BIONICS
A center for the study of early events in photosynthesis
[DE91-008509] N91-21698

BIOPROCESSING
Aerobic production of ethanol
[PB91-119172] N91-21324
Spiral vane bioreactor
[NASA-CASE-MSC-21361-1] N91-21701

BIOREACTORS
Rotating bio-reactor cell culture apparatus
[NASA-CASE-MSC-21293-1] N91-21700

Spiral vane bioreactor
[NASA-CASE-MSC-21361-1] N91-21701

BIOSPHERE
Bibliography on the international network of biosphere reserves
[PB90-215518] N91-21600

BIOTECHNOLOGY
Rotating bio-reactor cell culture apparatus
[NASA-CASE-MSC-21293-1] N91-21700

BIRD-AIRCRAFT COLLISIONS
Study of bird ingestions into small inlet area aircraft turbine engines
[DOT/FAA/CT-90/13] N91-21122

BIVARIATE ANALYSIS
Probability estimates of cloud-obscured line-of-sight
[AD-A231151] N91-21678

BLACK BODY RADIATION
Effects of source correlations on the spectrum of radiated fields
[AD-A230955] N91-21411

BLACKOUT (PHYSIOLOGY)
Enhancing tolerance to acceleration (+Gz) stress: The Hook maneuver
[AD-A231094] N91-21707
High G physiological protection training
[AGARD-AG-322] N91-21720

BLACKOUT PREVENTION
High G physiological protection training
[AGARD-AG-322] N91-21720

BLADE SLAP NOISE
Velocity measurements in a turbulent trailing vortex and their application to BWI noise prediction
[NASA-CR-188083] N91-21100
Blade-wake interaction on a two blade rotor with prediction of the radiated noise stationary and forward flight, comparison between calculation, and experiment
[ISL-R-120/89] N91-21832

BLADE-VORTEX INTERACTION
Velocity measurements in a turbulent trailing vortex and their application to BWI noise prediction
[NASA-CR-188083] N91-21100
Calculation of thickness and charge noise radiated by a rotor in forward flight
[ISL-R-119/89] N91-21831
Blade-wake interaction on a two blade rotor with prediction of the radiated noise stationary and forward flight, comparison between calculation, and experiment
[ISL-R-120/89] N91-21832

BLAZARS
Submillimeter observations of extragalactic objects in the wavelength range 50 microns to 1 mm N91-21994
The importance of submillimetre observations of radio quiet and radio loud AGN's N91-22000

BLOCK COPOLYMERS
Synthesis of imide/arylene ether copolymers for adhesives and composite matrices
[NASA-TM-104067] N91-21306
Imide/arylene ether block copolymers
[NASA-TM-104066] N91-21308

BLOOD PRESSURE
Enhancing tolerance to acceleration (+Gz) stress: The Hook maneuver
[AD-A231094] N91-21707

BLUNT BODIES
Investigation of nose bluntness and angle of attack effects on slender bodies in viscous hypertension flows
[NASA-CR-188153] N91-21117

BLUNT LEADING EDGES
Two and three-dimensional shock-shock interactions on the blunt leading edges of the hypersonic inlets N91-21088

BLUNT TRAILING EDGES
Blunt trailing edge analysis of supercritical airfoils by a Navier-Stokes code
[NAL-TR-1075-T] N91-21114

BODY CENTERED CUBIC LATTICES
Interplay between local environment effect and electronic structure properties in close packed structures
[DE91-008506] N91-21915

BODY-WING AND TAIL CONFIGURATIONS
MATGRID, a program for generation of C-H and C-O topology grids around wing/body configurations: User's guide
[FFA-TN-1991-03] N91-21110

BOLOMETERS
A submillimeter mission for the 1990s: SMMM N91-22019
PRONAOS N91-22020
Sub-mm direct photometry with large telescopes N91-22027
SCUBA: A submillimetre camera N91-22044

BOLTZMANN TRANSPORT EQUATION
Modeling failure and reliability in new-generation devices
[AD-A230998] N91-21439
Stability analysis of time-dependent transport algorithms
[DE91-009170] N91-21750

BOOSTER ROCKET ENGINES
The energy source rocket of the Soviet Union
[AD-A224938] N91-21229
Solid rocket booster internal flow analysis by highly accurate adaptive computational methods
[NASA-CR-184141] N91-21239

BORN APPROXIMATION
Electron distortion effects in quasi-elastic electron scattering
[DE91-009034] N91-21843

BORON CARBIDES
On the crystal structure of boron carbides
[DE91-009256] N91-21914

BORON 10
Colorado School of Mines fusion gamma ray diagnostic project
[DE91-009259] N91-21889

BORON-EPOXY COMPOSITES
Analysis of failure in woven carbon/epoxy laminates under quasi-static and impact loading N91-21248

BOUNDARY CONDITIONS
Description and evaluation of an interference assessment for a slotted-wall wind tunnel
[NASA-CR-4352] N91-21155
Application of the finite element method to random rough surface scattering with Neumann boundary conditions
[AD-A231583] N91-21420
Layer tracking asymptotics and domain decomposition
[DE91-008593] N91-21462
Some treatments on boundary conditions for quasi one-dimensional Euler equations
[FFA-TN-1990-36] N91-21469
On the slowness of phase boundary motion in one space dimension
[AD-A231286] N91-21480
Thermal buckling and postbuckling of symmetrically laminated composite plates
[NASA-CR-188030] N91-21560
Global monthly sea surface temperature climatology
[PB91-129304] N91-21669
Numerical anaiysis and computation of nonlinear partial differential equations from applied mathematics
[AD-A231188] N91-21806
The streamlined Darwin field method (and a solution technique that makes it practical)
[DE91-009482] N91-21903

BOUNDARY INTEGRAL METHOD
On the mapping properties of boundary integral operators for Navier-Stokes like equations
[FFA-TN-1989-41] N91-21467

BOUNDARY LAYER CONTROL
An experimental study of a three-dimensional swept-back wing with suction laminar-flow-control
[NAL-TR-1072] N91-21113

BOUNDARY LAYER EQUATIONS
Finite difference form of the compressible boundary layer equations in generalized curvilinear coordinates
[AD-A231386] N91-21483

BOUNDARY LAYER FLOW
Numerical investigation of an internal layer in turbulent flow over a curved hill N91-21083
Heat transfer, velocity-temperature correlation, and turbulent shear stress from Navier-Stokes computations of shock wave/turbulent boundary layer interaction flows N91-21085
On the nonlinear stability of a high-speed, axisymmetric boundary layer
[NASA-CR-187538] N91-21099
An experimental study of a three-dimensional swept-back wing with suction laminar-flow-control
[NAL-TR-1072] N91-21113
Estimations of ABL fluxes and other turbulence parameters from Doppler lidar data
[NASA-CR-188062] N91-21648

BOUNDARY LAYER SEPARATION
Prediction of unsteady transonic separated flow for missile applications
[AD-A231259] N91-21120
A simple model vortex flow past a slender elliptic cone at incidence
[RAE-TM-AERO-2197] N91-21460
Transition and turbulence
[ESA-TT-1219] N91-21465

BOUNDARY LAYER TRANSITION
Experimental study of boundary layer transition on a heated flat plate
[NASA-TM-103779] N91-21061
Transition and turbulence
[ESA-TT-1219] N91-21465
Graduate fellowship in hypersonics
[AD-A231263] N91-21478

BOUNDARY LAYERS
On the nonlinear stability of a high-speed, axisymmetric boundary layer
[NASA-CR-187538] N91-21099
A simple, analytical, axisymmetric microburst model for downdraft estimation
[NASA-TM-104053] N91-21132
Boundary layer study. Phase 4: Experimental validation test plan
[AD-A231342] N91-21481
Boundary layer study
[AD-A231343] N91-21482
Slant hot-wire inclination measurement using dual laser beams
[NAL-TR-1078] N91-21491
Dynamics of oceanic motions
[AD-A231135] N91-21693

BOUNDARY VALUE PROBLEMS
Compressible flows with periodic vortical disturbances around lifting airfoils
[NASA-TM-103742] N91-21060
Existence and uniqueness results for problems arising in connection with the incompressible Navier-Stokes equations
[FFA-TN-1989-43] N91-21468
Some treatments on boundary conditions for quasi one-dimensional Euler equations
[FFA-TN-1990-36] N91-21469

BOW WAVES
Data analysis for the Pioneer-Venus electric field detector
[NASA-CR-188099] N91-22056

BRAGG ANGLE
Experimental investigation of scattering of magnetostatic waves by surface acoustic waves
[DE91-009435] N91-21835

BRAKES (FOR ARRESTING MOTION)
Determination of the flight hardware configuration of an energy absorbing attenuator for the proposed Space Station crew and equipment translation aid cart
[NASA-TP-3084] N91-21556

BRAZIL
Evaluation of TM/LANDSAT-5 bands in the discrimination of wheat and beam crops
[INPE-5204-PRE/1666] N91-21602
Spot 1: Imagery in geologic mapping: A comparative study with several remote sensing products in the Curaca River Valley, Bahia
[INPE-5136-PRE/1624] N91-21608
Characterization of antropic action in the Mearim (MA) middle-low valley through LANDSAT/TM imagery
[INPE-5075-PRE/1594] N91-21620
Evaluation of indigenous areas utilizing TM/LANDSAT data
[INPE-5173-PRE/1642] N91-21636

BRIGHTNESS
High brightness electron beam production by laser induced various order multiphoton photoeffects of gold
[DE91-009150] N91-21514

BRILLOUIN EFFECT
Optical properties of a nuclear reactor pumped gas laser
[DE91-009226] N91-21507
Stochastic and deterministic fluctuations in stimulated Brillouin scattering
[AD-A230988] N91-21522

BROADBAND
Statistical properties of the sea surface sound dipole source
[AD-A230811] N91-21688
A study of rotor broadband noise mechanisms and helicopter tail rotor noise
[NASA-CR-177565] N91-21829

BUBBLES
Optical scattering methods applicable to drops and bubbles N91-21358

BUCKLING
Thermal buckling and postbuckling of symmetrically laminated composite plates
[NASA-CR-188030] N91-21560
A method for the geometrically nonlinear analysis of compressively loaded prismatic composite structures
[NASA-CR-184846] N91-21561
Comparison of the post-buckling behavior of metallic and composite plates with centrally located cu touts
[PB91-118844] N91-21563
Stability analysis of a fuselage side
[FFA-TN-1990-32] N91-21568
Stacking-sequence optimization for buckling of laminated plates by integer programming
[NASA-TM-104033] N91-21580

BUFFETING
Dynamic response of a hammerhead launch vehicle wind-tunnel model
[NASA-TM-104050] N91-21177

BUOYS
Experiment on rapidly intensifying cyclones over the Atlantic
[AD-A231377] N91-21682
BURGER EQUATION
Uniform high order spectral methods for one and two dimensional Euler equations
[NASA-CR-187535] N91-21456
BURNING RATE
Effect of equations of state on transient burning analysis of pyrotechnic materials in a closed system
[DE91-009167] N91-21280
Combustion tests of black-powder substitutes for the hand-held signal flare
[AD-A231501] N91-21330
BUSHINGS
Overcenter collet space station truss fastener
[NASA-CASE-MSC-21504-1] N91-21221

C

C (PROGRAMMING LANGUAGE)
Implementation in two classes of C (++) for morphological processing of images
[INPE-5217-RPE/642] N91-21744
Single board system for fuzzy inference N91-21784
C-141 AIRCRAFT
Submillimeter observations with the Kuiper Airborne Observatory N91-21987
CALCIUM
Laser pulse compression in strontium and calcium vapor
[DE91-007346] N91-21511
CALCIUM ISOTOPES
Electron distortion effects in quasi-elastic electron scattering
[DE91-009034] N91-21843
CALIBRATING
Preliminary calibration of a generic scramjet combustor
[NASA-CR-187539] N91-21139
Description and evaluation of an interference assessment for a slotted-wall wind tunnel
[NASA-CR-4352] N91-21155
Report of the panel on international programs N91-21599
Calibration transfer target for a microwave radiometric profiling system
[PB91-129080] N91-21647
Measurement capabilities of the Sandia, Livermore, Standards Laboratories
[DE91-008124] N91-21825
Frequency response calibration of recess-mounted pressure transducers
[NASA-TM-104031] N91-21834
CALORIMETERS
Test results of a 90 MHz integrated circuit sixteen channel analog pipeline for SSC detector calorimetry
[DE91-009773] N91-21436
CANOPIES (VEGETATION)
Climate variability and ecosystem response: Proceedings of a Long-Term Ecological Research Workshop
[PB91-119180] N91-21632
CANTILEVER BEAMS
Contributions to the analysis of the DCB-specimen
[FFA-TN-1990-22] N91-21567
CAPACITANCE
Pressure dependence of deep centers by capacitance spectroscopies inside the diamond anvil cell
[DE91-008927] N91-21906
CAPILLARY TUBES
High-performance capillary electrophoresis of histones
[DE91-008585] N91-21275
CAPILLARY WAVES
Using a microgravity environment to probe wave turbulence N91-21355
CARBON
A systematic investigation of the preparation and properties of composite carbon molecular sieves containing inorganic oxides N91-21353
The (C II) 158 micron line mapping of spiral galaxies N91-21996
Investigation of highly excited CO transitions in OMC-1 N91-22013
CARBON DIOXIDE
Fire suppression in human-crew spacecraft
[NASA-TM-104334] N91-21182
Cooling of in-situ propellant rocket engines for Mars mission
[NASA-TM-103729] N91-21233
Photoassisted reaction of H2 with CO2 over solid catalysts
[AD-A231045] N91-21282
CO2 induced inhibition of the localized corrosion of aluminum, Al-0.5 percent Cu, and Al-2 percent Cu in dilute HF solution
[DE91-005312] N91-21292
Sources of volcanic aerosols: Petrologic and volcanological constraints N91-21644
Recommended carbon dioxide and relative humidity levels for maintaining acceptable indoor air quality
[AD-A230026] N91-21717
Post-encapsulation plutonia reduction for Galileo and Ulysses GPHS modules: The Module Reduction and Monitoring Facility (MRMF)
[DE91-008131] N91-21861
CARBON FIBER REINFORCED PLASTICS
Thermomechanics tasks and applications
[DLR-MITT-90-14] N91-21254
CARBON MONOXIDE
Cooling of in-situ propellant rocket engines for Mars mission
[NASA-TM-103729] N91-21233
Catalyst for carbon monoxide oxidation
[NASA-CASE-LAR-14155-2-SB] N91-21270
Inhalation toxicology. 11: The effect of elevated temperature on carbon monoxide toxicity
[AD-A231185] N91-21708
A highly collimated bipolar outflow in the core of OMC-1: CO submillimeter emission N91-22014
CARBON 13
Artifact diamond characterization
[AD-A231555] N91-21323
CARGO AIRCRAFT
Evaluation of an alternative rotorcraft cargo lowering device for the delivery of 500-lb ammunition loads
[AD-A230995] N91-21133
CARTS
Determination of the flight hardware configuration of an energy absorbing attenuator for the proposed Space Station crew and equipment translation aid cart
[NASA-TP-3084] N91-21556
CASCADE FLOW
Computational study of three dimensional viscous flow through a turbine cascade using a multi-domain spectral technique N91-21066
Transonic cascade flow calculations using non-periodic C-type grids N91-21071
Computation of supersonic and low subsonic cascade flows using an explicit Navier-Stokes technique and the kappa-epsilon turbulence model N91-21072
CASSEGRAIN OPTICS
Image quality of the PRONAOS telescope N91-22039
CATALYSTS
Catalyst for carbon monoxide oxidation
[NASA-CASE-LAR-14155-2-SB] N91-21270
Control of catalytic hydrotreating selectivity with ammonia
[DE91-008405] N91-21272
Photoassisted reaction of H2 with CO2 over solid catalysts
[AD-A231045] N91-21282
CAUCHY PROBLEM
Experimental and theoretical studies of vertical annular liquid jets
[DE91-008042] N91-21461
Classification of intermittent dependent observations
[AD-A231605] N91-21811
CAUSES
Using artificial intelligence to aid in the development of causal models
[AD-A231273] N91-21794
CAVITY RESONATORS
Theory of semiconductor laser feedback instability
[DE91-008198] N91-21512
CELLS (BIOLOGY)
Rotating bio-reactor cell culture apparatus
[NASA-CASE-MSC-21293-1] N91-21700
Spiral vane bioreactor
[NASA-CASE-MSC-21361-1] N91-21701
CENTRAL PROCESSING UNITS
Utilization of GPIOP in the matrix processor FPS-5410
[INPE-5152-RPE/634] N91-21747
The IBM RISC System/6000 and linear algebra operations
[DE91-009221] N91-21805
CENTRIFUGES
Design and construction of a formed pulse circuit for a plasma centrifuge
[INPE-5161-RPE/639] N91-21895
CERAMIC FIBERS
A simple test for thermomechanical evaluation of ceramic fibers
[NASA-TM-103767] N91-21309
CERAMIC MATRIX COMPOSITES
Mechanical behavior of fiber reinforced SiC/RBSN ceramic matrix composites: Theory and experiment
[NASA-TM-103688] N91-21243
Transverse cracking in a fiber reinforced ceramic matrix composite
[AD-A231029] N91-21259
Engineering property limitations of structural ceramics and ceramic composites above 1600 C
[DE91-009105] N91-21311
CERAMICS
Fracture toughness of unidirectional fiber reinforced ceramic composites in Mode 2 utilizing laser interferometry
[AD-A231027] N91-21258
Vibrational frequencies for model silicates: Extensions beyond molecular properties
[DE91-008828] N91-21310
Engineering property limitations of structural ceramics and ceramic composites above 1600 C
[DE91-009105] N91-21311
Containerless synthesis of ceramic materials using microwave heating N91-21360
Containerless processing of amorphous ceramics N91-21367
Spatial variations in ac susceptibility and microstructure for the YBa2Cu3O(7-x) superconductor and their correlation with room-temperature ultrasonic measurements
[NASA-TM-103787] N91-21553
CERENKOV COUNTERS
Cosmic Ray Nuclei (CRN) detector investigation
[NASA-CR-184137] N91-22063
CERIUM
XANES (X ray Absorption Near Edge Structure) investigation of cerium as an inhibitor for Al alloys
[DE91-005542] N91-21293
Double 4f-collapse in Ce(0.9-x)Yb(x)Th(0.1)
[DE91-619752] N91-21908
CERIUM COMPOUNDS
Nonlinear optical spectroscopy of Ce3(+) ions in insulating crystals
[DE91-008928] N91-21913
CESIUM
Navigation Experiment NAVEX: Measurement and performance of the spaceborne clocks
[ESA-TT-1209] N91-21823
CHANGE DETECTION
Experiences in assessing changes in the use of savanna ecosystems
[INPE-5187-PRE/1655] N91-21605
CHANNEL FLOW
Characteristic eddy decomposition of turbulence in a channel
[NASA-TM-100065] N91-21470
CHANNEL NOISE
Noise effects upon a simple timing channel
[AD-A230818] N91-21726
CHANNELS (DATA TRANSMISSION)
Hypermedia = hypercommunication N91-21953
CHAOS
Predicting chaos for infinite dimensional dynamical systems: The Kuramoto-Sivashinsky equation, a case study
[NASA-CR-187531] N91-21454
Chaotic and random processes
[DE91-008574] N91-21804
Chaotic spectra of small molecules
[AD-A231638] N91-21859
Stabilities of regular motion in the relativistic standard map
[NIFS-73] N91-21894
CHARACTERIZATION
The overall response of composite materials undergoing large elastic deformations
[AD-A231637] N91-21260
Imide/arylene ether block copolymers
[NASA-TM-104066] N91-21308
Long-term performance and propagation measurements on single and tandem digital microwave transmission links. Volume 1: Analysis of measurement data
[PB91-129643] N91-21396
Preparation and characterization of Iron(III) oxide films by an novel spray pyrolysis method
[AD-A231047] N91-21920
CHARGE CARRIERS
Molecular beam epitaxial growth and electronic properties of GaP-on-Si (211) heterostructures, and of related systems
[AD-A231125] N91-21921
CHARGE COUPLED DEVICES
Description of the Large-Gap Magnetic Suspension System (LGMSS) ground based experiment N91-21200
CHARGE TRANSFER
Photochemistry and charge transfer chemistry of the platinum group elements
[DE91-009153] N91-21277

CHARGED PARTICLES
Stabilities of regular motion in the relativistic standard map
[NIFS-73] N91-21894
CHEBYSHEV APPROXIMATION
Computational study of three dimensional viscous flow through a turbine cascade using a multi-domain spectral technique N91-21066
CHEMICAL ANALYSIS
Rapid determination of drugs and semivolatile organics by direct thermal desorption ion trap mass spectrometry
[DE91-008885] N91-21278
Enhanced selectivity and detectability in absorption and fluorescence methods based on polarization modulation
[DE91-008926] N91-21279
Synthesis, structure, and properties of segmented polyurethanes
[AD-A230966] N91-21319
Nondestructive imaging of materials microstructure using x ray tomographic microscopy
[DE91-008505] N91-21554
Performance tests on Ge:Ga and Ge:Be detectors for the ISO long wavelength spectrometer N91-22045
MOSES: A proposed Swedish submillimeter satellite for combined astronomical and atmospheric observations N91-22050
CHEMICAL BONDS
Contributions of conformational and structural defects to the hyper-polarizabilities of polymers
[DE91-009042] N91-21313
Strength of polymer interfaces
[AD-A230839] N91-21318
CHEMICAL COMPOSITION
An evaluation of the effects of varying composition and processing on several encapsulating resins
[DE91-009101] N91-21314
Artifact diamond characterization
[AD-A231555] N91-21323
On the crystal structure of boron carbides
[DE91-009256] N91-21914
Cosmic Ray Nuclei (CRN) detector investigation
[NASA-CR-184137] N91-22063
CHEMICAL EFFECTS
Historical evidence for a connection between volcanic eruptions and climate change N91-21642
CHEMICAL EQUILIBRIUM
Effect of equations of state on transient burning analysis of pyrotechnic materials in a closed system
[DE91-009167] N91-21280
CHEMICAL PROPERTIES
An evaluation of the effects of varying composition and processing on several encapsulating resins
[DE91-009101] N91-21314
CHEMICAL PROPULSION
Advanced expander test bed program
[NASA-CR-187082] N91-21234
Theoretical investigation leading to energy storage in atomic and molecular systems
[AD-A231275] N91-21858
CHEMICAL REACTIONS
Control of catalytic hydrotreating selectivity with ammonia
[DE91-008405] N91-21272
In-situ x ray measurements of pit solutions during localized corrosion
[DE91-006916] N91-21295
Vibrational frequencies for model silicates: Extensions beyond molecular properties
[DE91-008828] N91-21310
Fundamental investigation of micelles and microemulsions in supercritical fluids
[AD-A231073] N91-21476
CHIPS
Single board system for fuzzy inference N91-21784
CHIPS (ELECTRONICS)
Laterally stacked Schottky diodes for infrared sensor applications
[NASA-CASE-NPO-17426-1-CU] N91-21434
CHIRP SIGNALS
SAW technology for multicarrier demodulation in advanced payloads N91-21164
CHLORINE COMPOUNDS
Preliminary field demonstration of a fiber-optic TCE sensor
[DE91-008453] N91-21498
CHLOROPHYLLS
Remote sensing estimation of total chlorophyll pigment distribution in Barra Bonita Reservoir
[INPE-5202-PRE/1664] N91-21603
WINTER 1990 hydrographics data report: CTD station profiles, sections, nutrients, SAIL, January - February 1990
[DE91-008286] N91-21686
CHROMATES
A study of the inhibition of pitting of aluminum by chromate
[DE91-006915] N91-21294
CHROMIUM CARBIDES
Mechanical strength and thermophysical properties of PM212: A high temperature self-lubricating powder metallurgy composite
[NASA-TM-103694] N91-21302
CHROMOSOMES
High-performance capillary electrophoresis of histones
[DE91-008585] N91-21275
X ray laser holography of biological microstructures
[DE91-008732] N91-21488
CIRCUIT BOARDS
Resistance seam welding thin copper foils
[DE91-008988] N91-21535
CIRCUIT PROTECTION
Kapton wire arc track testing: Per test procedure KWATT BB01
[NASA-CR-185642] N91-21427
CIRCUITS
Analysis and design of antenna structures: Diakoptic theory and the moment method
[AD-A230838] N91-21438
CIRCULATION CONTROL AIRFOILS
An experimental investigation of circulation control flow fields using holographic interferometry
[NASA-CR-166482] N91-21459
CIRRUS CLOUDS
The 0 deg (63 micron) line emission from galactic high latitude cirrus clouds N91-22029
CITIES
Proposed methodology for the study of urban environment and space structure in metropolitan area
[INPE-5203-PRE/1665] N91-21216
Data integration of different sensor systems through the technique of IHS transformation, the purpose and study of intra-urban structure
[INPE-5171-PRE/1640] N91-21616
CLAMPS
Overcenter collet space station truss fastener
[NASA-CASE-MSC-21504-1] N91-21221
CLASSICAL MECHANICS
Physics without physical constants
[DE91-619576] N91-21935
Quantization of nonlocal theories and gravitation
[DE91-619626] N91-21937
CLASSIFICATIONS
Flight set 360L007 (STS-33) insulation component. Volume 3: Final release
[NASA-CR-184091] N91-21230
Cloud classification of DMSP visible and IR imagery using physical and textural features
[AD-A231186] N91-21680
Self-organization and clustering algorithms N91-21783
Classification of intermittent dependent observations
[AD-A231605] N91-21811
CLEAN ROOMS
How clean is clean. How clean is needed
[DE91-008173] N91-21391
CLEANERS
Orbital debris sweeper and method
[NASA-CASE-MSC-21534-1] N91-21222
CLEANING
Orbital debris sweeper and method
[NASA-CASE-MSC-21534-1] N91-21222
How clean is clean. How clean is needed
[DE91-008173] N91-21391
Surface cleaning by laser ablation
[DE91-009189] N91-21505
CLEANLINESS
How clean is clean. How clean is needed
[DE91-008173] N91-21391
Effective cleaning of oil-protected bearing steel examined by XPS analysis. Part 1: Cleaning by solvents and alkaline cleaners
[NAL-TR-1074] N91-21538
CLIMATE
Report of the panel on volcanology, section 4 N91-21593
Report of the panel on the land surface: Process of change, section 5 N91-21594
Environmental Research Laboratories publication abstracts, fiscal year 1990
[PB91-132035] N91-21627
Climate variability and ecosystem response: Proceedings of a Long-Term Ecological Research Workshop
[PB91-119180] N91-21632
Using climate model output to assess the impacts of climate change on water resources
[DE91-004542] N91-21637
Volcanism-Climate Interactions
[NASA-CP-10062] N91-21641
Climatic impact of volcanic eruptions N91-21643
Volcanic aerosols: Chemistry, evolution, and effects N91-21645
Volcanic effects on climate N91-21646
Current velocity and hydrographic observations in the southwestern North Atlantic Ocean: Subtropical Atlantic Climate Studies (STACS), 1989
[PB91-115535] N91-21685
CLIMATE CHANGE
Report of the panel on the land surface: Process of change, section 5 N91-21594
Using climate model output to assess the impacts of climate change on water resources
[DE91-004542] N91-21637
Polar research from satellites
[NASA-CR-188025] N91-21640
Historical evidence for a connection between volcanic eruptions and climate change N91-21642
Volcanic effects on climate N91-21646
CLIMATOLOGY
Climatic impact of volcanic eruptions N91-21643
Sources of volcanic aerosols: Petrologic and volcanological constraints N91-21644
Volcanic aerosols: Chemistry, evolution, and effects N91-21645
Volcanic effects on climate N91-21646
Estimations of ABL fluxes and other turbulence parameters from Doppler lidar data
[NASA-CR-188053] N91-21665
Global monthly sea surface temperature climatology
[PB91-129304] N91-21669
Tropical cyclone track objective aids for the microcomputer: PCLM, XTRP, PCHP
[AD-A230851] N91-21675
Current velocity and hydrographic observations in the southwestern North Atlantic Ocean: Subtropical Atlantic Climate Studies (STACS), 1989
[PB91-115535] N91-21685
Objective use of satellite altimetry and IR in simulations of western boundary current dynamics
[AD-A231628] N91-21695
CLINICAL MEDICINE
Science, medicine and animals
[ISBN-0-309-04439-1] N91-21697
CLOCKS
Hypercube clock synchronization
[DE91-009222] N91-21774
CLOUD COVER
Cloud and ocean effects on global greenhouse warming
[DE91-008842] N91-21639
The oceanic cloudy atmosphere: Measurement requirements and solution options
[AD-A231121] N91-21677
Probability estimates of cloud-obscured line-of-sight
[AD-A231151] N91-21678
CLOUD PHYSICS
Volcanism-Climate Interactions
[NASA-CP-10062] N91-21641
Tactical Environmental Support System (TESS(3)) satellite cloud analyses
[AD-A231247] N91-21681
CLOUDS
User's manual for SLAB: An atmospheric dispersion model for denser-than-air-releases
[DE91-008443] N91-21638
CLOUDS (METEOROLOGY)
Historical evidence for a connection between volcanic eruptions and climate change N91-21642
Climatic impact of volcanic eruptions N91-21643
Satellite cloud analyses: A nowcasting capability for the US Navy's TESS(3)
[AD-A231120] N91-21676
Cloud classification of DMSP visible and IR imagery using physical and textural features
[AD-A231186] N91-21680
CLUMPS
Studies in clustering theory
[AD-A230967] N91-21475
CLUSTER ANALYSIS
Self-organization and clustering algorithms N91-21783
CLUTTER
Specification for a standard radar sea clutter model
[AD-A230848] N91-21409
CMOS
A demonstration of CMOS VLSI circuit prototyping in support of the site facility using the 1.2 micron standard cell library developed by National Security Agency
[NASA-CR-188014] N91-21426
Single board system for fuzzy inference N91-21784
COAL GASIFICATION
High octane ethers from synthesis gas-derived alcohol
[DE91-008367] N91-21325

COALESCING
Rheological properties, shape oscillations, and coalescence of liquid drops with surfactants N91-21357
Drop coalescence studies N91-21375
Center for low-gravity fluid mechanics and transport phenomena
[NASA-CR-188048] N91-21452
COANDA EFFECT
An experimental investigation of circulation control flow fields using holographic interferometry
[NASA-CR-166482] N91-21459
COASTS
Verification of parameters and morphological-environmental properties, by satellite imagery, for studies of coastal region planning
[INPE-5177-PRE/1646] N91-21606
COATINGS
Environmentally-induced passivity of aluminum alloys and aluminum metal matrix composites
[AD-A231350] N91-21301
Dip coating of sol-gels
[DE91-007571] N91-21872
CODING
Experience with abstract notation one
[NASA-CR-188090] N91-21741
HEAVENS system for software artifacts N91-21958
Source header list. Volume 1: A through K
[AD-A231000] N91-21971
Source header list. Volume 2: L through Z
[AD-A231001] N91-21972
COEFFICIENT OF FRICTION
Practical methods to evaluate the friction drag coefficient of a projectile in free flight
[ISL-R-123/89] N91-21105
COGNITION
The development of perceptual/motor and cognitive performance measures under a high-G environment: A preliminary study
[AD-A231289] N91-21709
Human performance concerns for the TRACKWOLF system
[AD-A231359] N91-21722
Designing a training tool for imaging mental models
[NASA-CR-187891] N91-21776
First Annual Meeting of International Neural Network Society
[AD-A230283] N91-21777
A model for addressing navigation limitations and metacognitive constraints in hypermedia training systems N91-21945
COGNITIVE PSYCHOLOGY
Predicting F-14 Air Combat Maneuvering (ACM) performance using an automated battery of cognitive/psychomotor tests
[AD-A228593] N91-21128
From knowledge presentation to knowledge representation to knowledge construction: Future directions for hypermedia N91-21954
COHERENT RADIATION
Free electron lasers
[AD-A230817] N91-21519
Coherent and incoherent detection N91-22010
COINCIDENCE CIRCUITS
Scattering in the time domain from submerged elastic shells at coincidence frequencies
[AD-A231122] N91-21837
COLLISION AVOIDANCE
Human factors in aviation: Terminal control area boundary conflicts
[NASA-CR-177522] N91-21714
COLLISIONS
Non-airborne conflicts: The causes and effects of runway transgressions
[NASA-CR-177372] N91-21121
Center for low-gravity fluid mechanics and transport phenomena
[NASA-CR-188048] N91-21452
COLLOIDS
Studies in clustering theory
[AD-A230967] N91-21475
COLOR
Enhanced single layer multi-color or luminescent display with coactivators
[NASA-CASE-LAR-14181-1] N91-21911
COLUMNS (SUPPORTS)
Determination of the flight hardware configuration of an energy absorbing attenuator for the proposed Space Station crew and equipment translation aid cart
[NASA-TP-3084] N91-21556
COMBAT
Predicting F-14 Air Combat Maneuvering (ACM) performance using an automated battery of cognitive/psychomotor tests
[AD-A228593] N91-21128
COMBINATORIAL ANALYSIS
Continuation and bifurcation investigations in constrained optimization
[AD-A231639] N91-21769
Image recovery by simulated annealing
[AD-A230655] N91-21869
COMBUSTIBLE FLOW
Computational Fluid Dynamics Symposium on Aeropropulsion
[NASA-CP-3078] N91-21062
Recent update of the RPLUS2D/3D codes N91-21094
The direct simulation of high-speed mixing-layers without and with chemical heat release N91-21095
Computational modelling of dump combustors flowfield N91-21096
COMBUSTION
The PDF method for turbulent combustion N91-21080
Possibilities of trajectory modification
[ISL-CO-209/90] N91-21151
Fire suppression in human-crew spacecraft
[NASA-TM-104334] N91-21182
Heavy hydrocarbon main injector technology program
[NASA-CR-188082] N91-21235
Spray combustion modeling and evaluation
[DE91-007923] N91-21264
COMBUSTION CHAMBERS
Computational Fluid Dynamics Symposium on Aeropropulsion
[NASA-CP-3078] N91-21062
A highly efficient engineering tool for three-dimensional scramjet flowfield and heat transfer computations N91-21098
Preliminary calibration of a generic scramjet combustor
[NASA-CR-187539] N91-21139
High-pressure promoted combustion chamber
[NASA-CASE-MSC-21470-1] N91-21157
Study of the absorption lines widened by the effect of pressure, emitted by the combustion gases of propulsive powders
[ISL-R-124/89] N91-21237
Spray combustion modeling and evaluation
[DE91-007923] N91-21264
COMBUSTION CHEMISTRY
Laser probes of natural gas ignition chemistry
[PB91-127993] N91-21262
Spray combustion modeling and evaluation
[DE91-007923] N91-21264
Simulation of chemical kinetics in combustion
[DE91-008446] N91-21273
COMBUSTION EFFICIENCY
Combustion tests of black-powder substitutes for the hand-held signal flare
[AD-A231501] N91-21330
One way to reduce thermal effects in a piezoelectric pressure transducer mounted in the combustion chamber of a C.I. engine
[ISVR-TR-189] N91-21487
COMBUSTION PHYSICS
The PDF method for turbulent combustion N91-21080
On the dynamics of the combustion process of hydrogen-air and hydrogen-methane-air mixtures
[ESA-TT-1198] N91-21268
Effect of equations of state on transient burning analysis of pyrotechnic materials in a closed system
[DE91-009167] N91-21280
COMBUSTION PRODUCTS
Study of the absorption lines widened by the effect of pressure, emitted by the combustion gases of propulsive powders
[ISL-R-124/89] N91-21237
Heats of explosion at low pressures, 2
[AD-A231020] N91-21328
COMETARY ATMOSPHERES
Submillimetre photometry of comets N91-22052
COMETS
A search for episodic increases in upper atmospheric water vapor as evidence of an extraterrestrial source
[AD-A231598] N91-21660
Submillimetre observations of solar-system objects N91-22037
Submillimetre photometry of comets N91-22052
COMMAND AND CONTROL
Hypermedia and intelligent tutoring applications in a mission operations environment N91-21948
Integrating knowledge and control into hypermedia-based training environments: Experiments with HyperCLIPS N91-21949
COMMERCE
Compilation of air pollutant emission factor. Volume 1, supplement C: Stationary point and area sources, fourth edition
[PB91-125906] N91-21630
COMMUNICATING
Improving risk communication through interactive training in communication skills
[DE91-008366] N91-21402
COMMUNICATION NETWORKS
Performance effects of irregular communications patterns on massively parallel multiprocessors
[NASA-CR-187514] N91-21724
XTP for the NASA space station
[NASA-CR-188087] N91-21966
COMMUNICATION SATELLITES
Application of SAW technology in satellites for mobile services N91-21163
SAW technology for multicarrier demodulation in advanced payloads N91-21164
A new fabrication method for precision antenna reflectors for space flight and ground test
[NASA-TP-3078] N91-21185
COMPARISON
Field intercomparison of precipitation samplers for assessing wet deposition of organic contaminants
[PB91-125880] N91-21629
COMPATIBILITY
Elastomer compatibility with liquid propellant at elevated temperature
[AD-A230973] N91-21327
A compatibility assessment of the protective integrated hood mask with ANVIS night vision goggles
[AD-A229956] N91-21716
A field evaluation of the compatibility of the protective integrated hood mask with ANVIS night vision goggles
[AD-A230237] N91-21718
COMPILERS
Experience with abstract notation one
[NASA-CR-188090] N91-21741
COMPLEX COMPOUNDS
Photochemistry and charge transfer chemistry of the platinum group elements
[DE91-009153] N91-21277
COMPLEX SYSTEMS
Effective computational strategy for predicting the response of complex systems
[AD-A231153] N91-21441
COMPOSITE MATERIALS
Stress wave propagation in hybrid composite materials N91-21249
Mechanical behaviour of composite materials under impact loading N91-21250
Acoustic emission-fracture strength relations for Al/Gr composites
[DE91-009106] N91-21251
Flat tensile specimen design for advanced composites
[NASA-CR-185261] N91-21252
The overall response of composite materials undergoing large elastic deformations
[AD-A231637] N91-21260
Mechanical strength and thermophysical properties of PM212: A high temperature self-lubricating powder metallurgy composite
[NASA-TM-103694] N91-21302
Studies of a direct drive robot with a parallel configuration
[AD-A231265] N91-21548
Nondestructive imaging of materials microstructure using x ray tomographic microscopy
[DE91-008505] N91-21554
The effect of microstructure on the thermal conductivity of ZnS/diamond composites
[AD-A231349] N91-21928
COMPOSITE STRUCTURES
Impact damage in curved graphite/epoxy panels with clamped edges
[AD-A230853] N91-21257
A systematic investigation of the preparation and properties of composite carbon molecular sieves containing inorganic oxides N91-21353
A method for the geometrically nonlinear analysis of compressively loaded prismatic composite structures
[NASA-CR-184846] N91-21561
HITCAN for actively cooled hot-composite thermostructural analysis
[NASA-TM-103750] N91-21562
Comparison of the post-buckling behavior of metallic and composite plates with centrally located cu touts
[PB91-118844] N91-21563
Structural analysis and optimization of a propfan blade by use of the finite element method
[ESA-TT-1216] N91-21566
COMPOSITE WRAPPING
The interlaminar shear strength of woven carbon, woven glass and woven carbon/glass hybrid laminates under static and impact loading N91-21247
COMPRESSIBLE BOUNDARY LAYER
Finite difference form of the compressible boundary layer equations in generalized curvilinear coordinates
[AD-A231386] N91-21483

COMPRESSIBLE FLOW
Implicit solution of three-dimensional internal turbulent flows N91-21082
The 3D computation of single-expansion-ramp and scramjet nozzles N91-21092
Finite element methods for integrated aerodynamic heating analysis
[NASA-CR-188079] N91-21101
Finite element methods of analysis for 3D inviscid compressible flows
[NASA-CR-186271] N91-21463
COMPRESSION LOADS
The theory of temporal compression of intense pulses in a metal vapor
[DE91-005059] N91-21509
COMPRESSIVE STRENGTH
Mechanical behaviour of composite materials under impact loading N91-21250
Mechanical strength and thermophysical properties of PM212: A high temperature self-lubricating powder metallurgy composite
[NASA-TM-103694] N91-21302
COMPRESSOR EFFICIENCY
Development of a low noise 10 KJ-T refrigeration system
[AD-A231383] N91-21392
COMPRESSOR ROTORS
Critical speeds and forced response solutions for active magnetic bearing turbomachinery, part 2 N91-21210
COMPRESSORS
An experimental study of exit flow patterns in a multistage compressor in rotating stall
[AD-A231353] N91-21143
Development of a gas engine-driven chiller
[PB91-130237] N91-21389
Development of a low noise 10 KJ-T refrigeration system
[AD-A231383] N91-21392
Development of a low noise 10K J-T refrigeration system
[AD-A231461] N91-21393
COMPUTATION
Fast algorithms for signal processing
[AD-A231226] N91-21759
Functional specifications for mathematical computations
[DE91-006002] N91-21803
Radiation dose calculations with the Monte Carlo method
[DE91-008582] N91-21841
COMPUTATIONAL CHEMISTRY
Graphical user interfaces in computational chemistry
[DE91-009116] N91-21267
COMPUTATIONAL FLUID DYNAMICS
Compressible flows with periodic vortical disturbances around lifting airfoils
[NASA-TM-103742] N91-21060
Computational Fluid Dynamics Symposium on Aeropropulsion
[NASA-CP-3078] N91-21062
Thoughts on the chimera method of simulation of three-dimensional viscous flow N91-21063
Generation and use of unstructured grids for turbomachinery calculations N91-21064
Unstructured grid generation using the distance function N91-21065
Numerical solutions of 2-D multi-stage rotor/stator unsteady flow interactions N91-21070
Transonic cascade flow calculations using non-periodic C-type grids N91-21071
Computation of supersonic and low subsonic cascade flows using an explicit Navier-Stokes technique and the kappa-epsilon turbulence model N91-21072
Cost-effective accurate coarse-grid method for highly convective multidimensional unsteady flows N91-21075
Choice of velocity variables for complex flow computation N91-21076
Distributed Minimal Residual (DMR) method for acceleration of iterative algorithms N91-21077
A multidimensional finite element method for CFD N91-21079
Pressure algorithm for elliptic flow calculations with the PDF method N91-21081
Implicit solution of three-dimensional internal turbulent flows N91-21082
Numerical investigation of an internal layer in turbulent flow over a curved hill N91-21083
Computation of turbulent high speed mixing layers using a two-equation turbulence model N91-21084
Recent update of the RPLUS2D/3D codes N91-21094
Structures of non-circular cross-section: Dynamic response due to vortex shedding
[ESDU-90036] N91-21103
Blunt trailing edge analysis of supercritical airfoils by a Navier-Stokes code
[NAL-TR-1075-T] N91-21114
A modal aeroelastic analysis scheme for turbomachinery blading
[NASA-CR-187089] N91-21138
Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics: Prospects of Computational Fluid Dynamics and Super Computers in Aerospace Science and Technology
[NAL-SP-13] N91-21379
Computer requirements for further CFD development N91-21380
Present and future of CFD on the aero-engine development in IHI N91-21381
CFD research and systems in Kawasaki Heavy Industries and its future prospects N91-21382
The CFD analysis related aerospace in Fuji Heavy Industries, Ltd. N91-21383
Status and outlook of CFD technology at Mitsubishi Heavy Industries, Nagoya N91-21384
CFD simulation on a massively parallel processor N91-21387
The software system on parallel processor for computational fluid dynamics N91-21388
CFD for hypersonic propulsion
[NASA-TM-103791] N91-21447
Turbulent separated flow past a backward-facing step: A critical evaluation of two-equation turbulence models
[NASA-CR-187532] N91-21451
Predicting chaos for infinite dimensional dynamical systems: The Kuramoto-Sivashinsky equation, a case study
[NASA-CR-187531] N91-21454
Domain decomposition methods in computational fluid dynamics
[NASA-CR-187529] N91-21457
Application of computational fluid dynamics in high speed aeropropulsion
[NASA-TM-103780] N91-21458
Application of mesh generation to complex 3-D configurations
[AGARD-AR-268] N91-21464
Convergence of the point vortex method for the 3-D Euler equations
[AD-A231285] N91-21479
Large eddy simulation: Where do we stand
[AD-A230835] N91-21657
A modified SLIC material interface reconstruction algorithm for Eulerian codes
[DE91-009175] N91-21740
High performance computing for large eddy simulations: Today and tomorrow
[AD-A231220] N91-21758
The sound of moving bodies
[NASA-TM-103342] N91-21827
Calculation of thickness and charge noise radiated by a rotor in forward flight
[ISL-R-119/89] N91-21831
COMPUTATIONAL GRIDS
Thoughts on the chimera method of simulation of three-dimensional viscous flow N91-21063
Generation and use of unstructured grids for turbomachinery calculations N91-21064
Unstructured grid generation using the distance function N91-21065
Numerical solutions of 2-D multi-stage rotor/stator unsteady flow interactions N91-21070
Transonic cascade flow calculations using non-periodic C-type grids N91-21071
Cost-effective accurate coarse-grid method for highly convective multidimensional unsteady flows N91-21075
Choice of velocity variables for complex flow computation N91-21076
Implicit solution of three-dimensional internal turbulent flows N91-21082
Dynamics of local grid manipulations for internal flow problems N91-21090
Grid generation strategies for turbomachinery configurations N91-21091
On the anomaly of velocity-pressure decoupling in collocated mesh solutions
[NASA-TM-103769] N91-21448
Domain decomposition methods in computational fluid dynamics
[NASA-CR-187529] N91-21457
Finite element methods of analysis for 3D inviscid compressible flows
[NASA-CR-186271] N91-21463
Application of mesh generation to complex 3-D configurations
[AGARD-AR-268] N91-21464
The hemispheric eighth mesh terrain elevation and geography data sets
[AD-A231592] N91-21624
Performance effects of irregular communications patterns on massively parallel multiprocessors
[NASA-CR-187514] N91-21724
A modified SLIC material interface reconstruction algorithm for Eulerian codes
[DE91-009175] N91-21740
Normalized convergence rates for the PSMG method
[AD-A231311] N91-21764
A multiblock multigrid three-dimensional Euler equation solver
[NASA-TM-103424] N91-21795
COMPUTER AIDED DESIGN
Wind tunnel test of a propeller working in a low Reynolds number range
[NAL-TR-1071] N91-21112
Large liquid rocket engine transient performance simulation system
[NASA-CR-184099] N91-21232
Computer requirements for further CFD development N91-21380
Present and future of CFD on the aero-engine development in IHI N91-21381
CFD research and systems in Kawasaki Heavy Industries and its future prospects N91-21382
The CFD analysis related aerospace in Fuji Heavy Industries, Ltd. N91-21383
Status and outlook of CFD technology at Mitsubishi Heavy Industries, Nagoya N91-21384
CFD development present and prospects at NAL N91-21385
Optimal design study of high efficiency indium phosphide space solar cells
[NASA-TM-103763] N91-21433
Test generation for digital circuits using parallel processing
[AD-A231006] N91-21440
A plane-sweep algorithm for exact simulation of a quasi-static mechanical system of compliantly-connected rigid bodies (extended abstract)
[AD-A231324] N91-21550
HITCAN for actively cooled hot-composite thermostructural analysis
[NASA-TM-103750] N91-21562
Engineering specification and system design for CAD/CAM of custom shoes: UMC project effort
[NASA-CR-188049] N91-21733
Computer aided design tools and algorithms for submicron technologies
[AD-A231171] N91-21757
Geographic information systems: A primer
[AD-A231465] N91-21974
COMPUTER AIDED MANUFACTURING
Engineering specification and system design for CAD/CAM of custom shoes: UMC project effort
[NASA-CR-188049] N91-21733
An object oriented design and implementation of the IDEF(sub 0) essential model using Ada and an Ada based expert system
[AD-A230814] N91-21753
COMPUTER AIDED MAPPING
Design and development of the terrain information extraction system
[AD-A231166] N91-21623
Scan-line methods in spatial data systems
[AD-A231165] N91-21973
Geographic information systems: A primer
[AD-A231465] N91-21974
COMPUTER ANIMATION
Computer animation of NASTRAN displacements on IRIS 4D-series workstations: CANDI/ANIMATE postprocessing of NASHUA results
[DE91-008605] N91-21585
Graphical representation of parallel algorithmic processes
[AD-A231258] N91-21760
COMPUTER ASSISTED INSTRUCTION
Instructional Support System (ISS). Beginner's manual (Zenith 248 version only)
[PB91-127332] N91-21734
An endorsement-based approach to student modeling for planner-controlled intelligent tutoring systems
[NASA-CR-188177] N91-21739
Designing a training tool for imaging mental models
[NASA-CR-187891] N91-21776
SEPEC conference proceedings: Hypermedia and Infromation Reconstruction. Aerospace applications and research directions
[NASA-CR-187935] N91-21940
Hypermedia and intelligent tutoring applications in a mission operations environment N91-21948
Integrating knowledge and control into hypermedia-based training environments: Experiments with HyperCLIPS N91-21949
Automating hypertext for decision support N91-21951
Hypermedia as medium N91-21952

SEPEC conference proceedings: Hypermedia and Information Reconstruction. Aerospace applications and research directions. Addendum
[NASA-CR-187936] N91-21955
A knowledge base browser using hypermedia N91-21956

COMPUTER GRAPHICS
Survey of NCAR user needs for visualization tools. A research report of the Digital/NCAR joint research project
[PB91-115444] N91-21154
Graphical user interfaces in computational chemistry
[DE91-009116] N91-21267
Computer animation of NASTRAN displacements on IRIS 4D-series workstations: CANDI/ANIMATE postprocessing of NASHUA results
[DE91-008605] N91-21585
GEMPAK5. Part 2: GEMPLT programmer's guide, version 5.0
[NASA-TM-4261-PT-2] N91-21663
A toolkit for designing user interfaces
[AD-A231558] N91-21723
Instructional Support System (ISS). Beginner's manual (Zenith 248 version only)
[PB91-127332] N91-21734

COMPUTER INFORMATION SECURITY
A demonstration of CMOS VLSI circuit prototyping in support of the site facility using the 1.2 micron standard cell library developed by National Security Agency
[NASA-CR-188014] N91-21426
Noise effects upon a simple timing channel
[AD-A230818] N91-21726

COMPUTER NETWORKS
A research program in computer technology
[AD-A231025] N91-21727
Experience with abstract notation one
[NASA-CR-188090] N91-21741
An automatic parallelization tool for sequential programs
[AD-A229972] N91-21771
Administrative information systems plan, FY 1991 - FY 1995
[DE91-008072] N91-21964
Relational databases with NIAM models bid so long to top-down designs
[DE91-009191] N91-21965
XTP for the NASA space station
[NASA-CR-188087] N91-21966
Promoting a healthy skepticism with regard to information processing
[DE91-007697] N91-21968

COMPUTER PROGRAMMING
GEMPAK5. Part 1: GEMPAK5 programmer's guide, version 5.0
[NASA-TM-4261-PT-1] N91-21662
GEMPAK5. Part 2: GEMPLT programmer's guide, version 5.0
[NASA-TM-4261-PT-2] N91-21663
Determining concurrency in object-oriented design of real-time embedded systems using Ada
[AD-A230659] N91-21738
Software development standards for project cost management information system
[AD-A231282] N91-21762
Administrative information systems plan, FY 1991 - FY 1995
[DE91-008072] N91-21964

COMPUTER PROGRAMS
Recent update of the RPLUS2D/3D codes N91-21094
MATGRID, a program for generation of C-H and C-O topology grids around wing/body configurations: User's guide
[FFA-TN-1991-03] N91-21110
Wind tunnel test of a propeller working in a low Reynolds number range
[NAL-TR-1071] N91-21112
Survey of NCAR user needs for visualization tools. A research report of the Digital/NCAR joint research project
[PB91-115444] N91-21154
AEOSS design guide for system analysis on Advanced Earth-Orbital Spacecraft Systems
[NASA-TM-100772] N91-21223
AEOSS runtime manual for system analysis on Advanced Earth-Orbital Spacecraft Systems
[NASA-TM-100773] N91-21224
Graphical user interfaces in computational chemistry
[DE91-009116] N91-21267
CFD research and systems in Kawasaki Heavy Industries and its future prospects N91-21382
Optimal design study of high efficiency indium phosphide space solar cells
[NASA-TM-103763] N91-21433
Graduate fellowship in hypersonics
[AD-A231263] N91-21478
The Basis version of LASNEX
[DE91-009483] N91-21516
A comparison of calculational results with experimental data for long rod projectiles
[DE91-009006] N91-21536
Update of PRONTO 2D and PRONTO 3D transient solid dynamics program
[DE91-009183] N91-21564
STARS: An integrated general-purpose finite element structural, aeroelastic, and aeroservoelastic analysis computer program
[NASA-TM-101709-REV] N91-21587
Introduction to digital imagery processing
[INPE-5212-MD/46] N91-21612
User's manual for SLAB: An atmospheric dispersion model for denser-than-air-releases
[DE91-008443] N91-21638
Implementation of an oceanographic expert system: Problems, feedback, solutions
[AD-A230886] N91-21689
Implementation of a partitioned algorithm for simulation of large CSI problems
[CU-CSSC-91-4] N91-21730
Second-order discrete Kalman filtering equations for control-structure interaction simulations
[CU-CSSC-91-5] N91-21731
Instructional Support System (ISS). Beginner's manual (Zenith 248 version only)
[PB91-127332] N91-21734
Methodology development for the verification and validation of flight critical systems software, phase 1
[AD-A229932] N91-21735
Utilization of GPIOP in the matrix processor FPS-5410
[INPE-5152-RPE/634] N91-21747
Automated computer software development standards enforcement
[DE91-007328] N91-21748
An object oriented design and implementation of the IDEF(sub 0) essential model using Ada and an Ada based expert system
[AD-A230814] N91-21753
Graphical representation of parallel algorithmic processes
[AD-A231258] N91-21760
Software development standards for project cost management information system
[AD-A231282] N91-21762
An automatic parallelization tool for sequential programs
[AD-A229972] N91-21771
Using artificial intelligence to aid in the development of causal models
[AD-A231273] N91-21794
Automatic program correction of interferometry quadratic sensor errors. Application to the processing of signals from a VISAR interferometer
[ISL-R-127/89] N91-21799
The sound of moving bodies
[NASA-TM-103342] N91-21827
Engineering software development with HyperCard N91-21942
HEAVENS system for software artifacts N91-21958

COMPUTER STORAGE DEVICES
VM-CMS tutorial
[DE91-009444] N91-21725

COMPUTER SYSTEMS DESIGN
Computer requirements for further CFD development N91-21380
Method and apparatus for positioning a robotic end effector
[NASA-CASE-MSC-21476-1] N91-21542
Satellite cloud analyses: A nowcasting capability for the US Navy's TESS(3)
[AD-A231120] N91-21676
Digital optical computer global interconnect algorithm study
[AD-A230282] N91-21736
Access and operator methods for the Triton nested relational database system
[AD-A230608] N91-21962
Relational databases with NIAM models bid so long to top-down designs
[DE91-009191] N91-21965

COMPUTER SYSTEMS PERFORMANCE
Computer requirements for further CFD development N91-21380
The CFD analysis related aerospace in Fuji Heavy Industries, Ltd. N91-21383

COMPUTER SYSTEMS PROGRAMS
VM-CMS tutorial
[DE91-009444] N91-21725
A research program in computer technology
[AD-A231025] N91-21727

COMPUTER TECHNIQUES
Embedded computers: Navy's approach to developing patrol aircraft avionics system too risky
[AD-A230868] N91-21136
A method for the geometrically nonlinear analysis of compressively loaded prismatic composite structures
[NASA-CR-184846] N91-21561
Computer aided design tools and algorithms for submicron technologies
[AD-A231171] N91-21757
Designing a training tool for imaging mental models
[NASA-CR-187891] N91-21776
Numerical analysis methods. Volume 3: Autocorrection methods
[INPE-5196-MD/45] N91-21807
Strategic defense system: Stable design and adequate testing must precede decision to deploy
[AD-A230864] N91-21820
SEPEC conference proceedings: Hypermedia and Infromation Reconstruction. Aerospace applications and research directions
[NASA-CR-187935] N91-21940
Computer-assisted knowledge acquisition for hypermedia systems N91-21944
Hypermedia = hypercommunication N91-21953

COMPUTER VISION
Introduction to digital imagery processing
[INPE-5212-MD/46] N91-21612

COMPUTERIZED SIMULATION
Simulation of nap-of-the-Earth flight in helicopters
[NASA-TM-102830] N91-21131
The micrometeoroid impact hazard in space: Techniques for damage simulation by pulsed lasers and environmental modelling N91-21220
Solid rocket booster internal flow analysis by highly accurate adaptive computational methods
[NASA-CR-184141] N91-21239
Fast quasi-explicit finite difference simulation of electrochemical responses initiated by a discontinuous perturbation
[DE91-006917] N91-21271
A study of helium, Argon: Ethane gas mixtures used in drift chambers for large acceptance spectrometers in high magnetic fields
[AD-A231209] N91-21284
Vibrational frequencies for model silicates: Extensions beyond molecular properties
[DE91-008828] N91-21310
Theoretical studies of highly energetic CBES materials
[AD-A231340] N91-21329
Status and outlook of CFD technology at Mitsubishi Heavy Industries, Nagoya N91-21384
CFD simulation on a massively parallel processor N91-21387
An empirical study of combining communicating processes in a parallel discrete event simulation
[AD-A230982] N91-21412
Modeling failure and reliability in new-generation devices
[AD-A230998] N91-21439
On the anomaly of velocity-pressure decoupling in collocated mesh solutions
[NASA-TM-103769] N91-21448
GEOSIM: A numerical model for geophysical fluid flow simulation
[NASA-TM-103528] N91-21450
Application of mesh generation to complex 3-D configurations
[AGARD-AR-268] N91-21464
The Basis version of LASNEX
[DE91-009483] N91-21516
Stability analysis of a fuselage side
[FFA-TN-1990-32] N91-21568
Comparison of several system identification methods for flexible structures
[NASA-TM-104046] N91-21574
Computer animation of NASTRAN displacements on IRIS 4D-series workstations: CANDI/ANIMATE postprocessing of NASHUA results
[DE91-008605] N91-21585
Quasilinear simulation of auroral kilometric radiation by a relativistic Fokker-Planck code
[DE91-009736] N91-21656
Analysis of error in TOMS total ozone as a function of orbit and attitude parameters
[NASA-CR-4361] N91-21670
Objective use of satellite altimetry and IR in simulations of western boundary current dynamics
[AD-A231628] N91-21695
Analysis, preliminary design and simulation systems for control-structure interaction problems
[NASA-CR-188018] N91-21729
Implementation of a partitioned algorithm for simulation of large CSI problems
[CU-CSSC-91-4] N91-21730

Second-order discrete Kalman filtering equations for control-structure interaction simulations
[CU-CSSC-91-5] N91-21731
Parallel computations and control of adaptive structures N91-21732
GRESS: A preprocessor for sensitivity studies on FORTRAN programs
[DE91-009561] N91-21751
An object-oriented military simulation baseline for parallel simulation research
[AD-A231030] N91-21755
Computer aided design tools and algorithms for submicron technologies
[AD-A231171] N91-21757
Structural analysis on massively parallel computers
[DE91-009038] N91-21773
Documentation for the token ring network simulation system
[NASA-CR-188093] N91-21789
Effectiveness of bomber deployed autonomous airborne vehicles in finding rail mobile SS-24s
[DE91-009008] N91-21815
Proton depth dose distribution: 3-D calculation of dose distributions from solar flare irradiation
[AD-A231230] N91-22061

COMPUTERS
An annotated bibliography of hypobaric decompression sickness research conducted at the Crew Technology Division, USAF School of Aerospace Medicine, Brooks AFB, Texas from 1983 to 1988
[AD-A231355] N91-21710
A research program in computer technology
[AD-A231025] N91-21727

CONCURRENT PROCESSING
Determining concurrency in object-oriented design of real-time embedded systems using Ada
[AD-A230659] N91-21738

CONDENSERS (LIQUEFIERS)
Heat-rate improvements obtained with the use of enhanced tubes in surface condensers
[DE91-006565] N91-21449

CONDUCTING POLYMERS
The organic chemistry of conducting polymers
[DE91-009520] N91-21316
Electronic and ionic transport in processable conducting polymers
[AD-A231293] N91-21321
Observation of the photorefractive effect in a polymer
[AD-A231339] N91-21322

CONDUCTIVE HEAT TRANSFER
Frequency response of a supported thermocouple wire: Effects of axial conduction
[NASA-CR-188101] N91-21489

CONDUCTIVITY
Multiple sensor multifrequency eddy current monitor for solidification and growth N91-21362
Numerical recovery of certain discontinuous electrical conductivities
[NASA-CR-187543] N91-21800

CONES
A simple model vortex flow past a slender elliptic cone at incidence
[RAE-TM-AERO-2197] N91-21460

CONFERENCES
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[NASA-CP-3078] N91-21062
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[NASA-CR-187806] N91-21331
Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics: Prospects of Computational Fluid Dynamics and Super Computers in Aerospace Science and Technology
[NAL-SP-13] N91-21379
Improving risk communication through interactive training in communication skills
[DE91-008366] N91-21402
Solid earth science in the 1990s. Volume 2: Panel reports
[NASA-TM-4256-VOL-2] N91-21590
Seminar on anthropogenic emissions of greenhouse gases
[DE91-009110] N91-21634
Volcanism-Climate Interactions
[NASA-CP-10062] N91-21641
Large eddy simulation: Where do we stand
[AD-A230835] N91-21657
First Annual Meeting of International Neural Network Society
[AD-A230283] N91-21777
Proceedings of the Second Joint Technology Workshop on Neural Networks and Fuzzy Logic, volume 1
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Proceedings of the Gordon Conference on Photonuclear Reactions
[DE91-621717] N91-21846
Third Information Transfer Meeting
[PB91-123922] N91-21961
From ground-based to space-borne sub-mm astronomy
[ESA-SP-314] N91-21986

CONFIGURATION MANAGEMENT
Method and apparatus for configuration control of redundant robots
[NASA-CASE-NPO-17801-1-CU] N91-21544
Software development standards for project cost management information system
[AD-A231282] N91-21762

CONGRESSIONAL REPORTS
Space station: NASA's search for design, cost, and schedule stability continues
[GAO/NSIAD-91-125] N91-21187
NASA authorizations
[S-HRG-101-981] N91-21977
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Mission to Planet Earth N91-21980
Aeronautics and space technology N91-21981
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Commercial space programs N91-21983

CONICAL BODIES
Coning motion of slender bodies at high angles of attack
[NAL-TR-1059] N91-21111

CONJUGATE GRADIENT METHOD
Rapidly convergent algorithms for nonsmooth optimization
[AD-A231110] N91-21756

CONNECTORS
Connection space reduction mechanism
[NASA-CASE-GSC-13220-1] N91-21525

CONSERVATION
Bibliography on the international network of biosphere reserves
[PB90-215518] N91-21600

CONSERVATION EQUATIONS
Computational modelling of dump combustors flowfield N91-21096

CONSERVATION LAWS
On the application of ENO scheme with subcell resolution to conservation laws with stiff source terms N91-21074

CONSISTENCY
Comparing structurally different views of a VLSI design
[PB91-111757] N91-21425

CONSTANTAN
Stress-strain gage measurements on a Nevada Test Site (NTS) event using pairs of triple foil gages
[DE91-005061] N91-21497

CONSTANTS
Improved fits for the vibrational and rotational constants of many states of nitrogen and oxygen
[AD-A229996] N91-21263
Physics without physical constants
[DE91-619576] N91-21935

CONSTRUCTION
Pre-integrated structures for Space Station Freedom
[NASA-TM-102780] N91-21214
Construction site Voice Operated Information System (VOIS) test
[AD-A231633] N91-21424
Design and construction of a formed pulse circuit for a plasma centrifuge
[INPE-5161-RPE/639] N91-21895

CONSTRUCTION INDUSTRY
An economic analysis of counterfeit threaded fasteners in the construction industry
[AD-A231492] N91-21551

CONTACTORS
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[NASA-CR-187097] N91-21880

CONTAINERLESS MELTS
Proceedings of the First Workshop on Containerless Experimentation in Microgravity
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Charge of the containerless experimentation in microgravity N91-21332
Ground-based and microgravity containerless positioning technologies and facilities N91-21333
Very high temperature chemistry: Science justification for containerless experimentation in space N91-21334
NASA-sponsored containerless processing experiments N91-21335
Containerless processing projects N91-21336
Containerless processing in the European microgravity programme N91-21337
The Japanese containerless experiments N91-21338
Containerless processing of undercooled melts N91-21339
Containerless synthesis of interesting glasses N91-21340
Containerless experiments in fluid physics in microgravity N91-21341
Real-time measurement of materials properties at high temperatures by laser produced plasmas N91-21342
TEMPUS: A facility for containerless electromagnetic processing onboard spacelab N91-21349
TEMPUS: First results N91-21350
Reluctant glass formers and their applications in optical lens design N91-21351
Containerless protein crystal growth technology: Electrostatic multidrop positioner N91-21352
Containerless synthesis of ceramic materials using microwave heating N91-21360
Optical property measurements as a diagnostic tool for control of materials processing in space and on Earth N91-21366
Containerless processing of amorphous ceramics N91-21367
Radiographic instrumentation for DPM experiments N91-21373

CONTAMINANTS
Field intercomparison of precipitation samplers for assessing wet deposition of organic contaminants
[PB91-125880] N91-21629
Compilation of air pollutant emission factor. Volume 1, supplement C: Stationary point and area sources, fourth edition
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The study of plasma clouds around large active space structures
[AD-A230634] N91-21881

CONTAMINATION
Charge of the containerless experimentation in microgravity N91-21332

CONTINUITY (MATHEMATICS)
Analysis of periodic orbits about the Martian moons by continuation techniques
[AD-A231026] N91-22058

CONTINUITY EQUATION
A pressure based method for the solution of viscous incompressible turbomachinery flows N91-21078

CONTINUOUS SPECTRA
Study of the absorption lines widened by the effect of pressure, emitted by the combustion gases of propulsive powders
[ISL-R-124/89] N91-21237

CONTINUOUS WAVE LASERS
Stochastic and deterministic fluctuations in stimulated Brillouin scattering
[AD-A230988] N91-21522

CONTINUUM FLOW
The 1.3 mm continuum emission from circumstellar envelopes N91-22007

CONTINUUMS
The confusion limits to the sensitivity of submillimeter telescopes N91-22001

CONTROL EQUIPMENT
Dynamic and control assessment of the Space Station Freedom payload pointing system
[NASA-TM-101667] N91-21225

CONTROL MOMENT GYROSCOPES
A superconducting large-angle magnetic suspension N91-21191

CONTROL SIMULATION
Attitude control simulation of the data collecting satellite: SCD2
[INPE-5159-PRE/1638] N91-21218
Studies of a direct drive robot with a parallel configuration
[AD-A231265] N91-21548
Generalizing the hop: Object-level programming for legged motion
[AD-A231315] N91-21549
A remote visual interface tool for simulation control and display
[AD-A231019] N91-21754

CONTROL STABILITY
Integrated flight/propulsion control design for a STOVL aircraft using H-infinity control design techniques
[NASA-TM-104340] N91-21140
Dynamic and control assessment of the Space Station Freedom payload pointing system
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STARS: An integrated general-purpose finite element structural, aeroelastic, and aeroservoelastic analysis computer program
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CONTROL SYSTEMS DESIGN
Hot gas ingestion test results of a two-poster vectored thrust concept with flow visualization in the NASA Lewis 9- x 15-foot low speed wind tunnel
[NASA-TM-103258] N91-21116

Integrated flight/propulsion control system design based on a decentralized, hierarchical approach
[NASA-TM-103678] N91-21137
Integrated flight/propulsion control design for a STOVL aircraft using H-infinity control design techniques
[NASA-TM-104340] N91-21140
Eigenspace design of helicopter flight control systems
[AD-A231588] N91-21153
Magnetic suspension systems for space applications N91-21189
Advanced magnetic suspensions for vibration isolation and fast-attitude control of space-based generic pointing mounts N91-21190
A superconducting large-angle magnetic suspension N91-21191
A solid-state controllable power supply for a magnetic suspension wind tunnel N91-21199
Description of the Large-Gap Magnetic Suspension System (LGMSS) ground based experiment N91-21200
Aerospace Applications of Magnetic Suspension Technology, part 2
[NASA-CP-10066-PT-2] N91-21203
A time delay controller for magnetic bearings N91-21205
Microgravity vibration isolation: An optimal control law for the one-dimensional case N91-21206
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[NASA-TM-100772] N91-21223
AEOSS runtime manual for system analysis on Advanced Earth-Orbital Spacecraft Systems
[NASA-TM-100773] N91-21224
A preliminary evaluation of an F100 engine parameter estimation process using flight data
[NASA-TM-4216] N91-21446
Control of free-flying space robot manipulator systems
[NASA-CR-188026] N91-21527
Experiments in thrusterless robot locomotion control for space applications
[NASA-CR-188027] N91-21528
Passive dynamic controllers for nonlinear mechanical systems
[NASA-TM-104047] N91-21573
Active vibration absorber for CSI evolutionary model: Design and experimental results
[NASA-TM-104048] N91-21578
Analysis, preliminary design and simulation systems for control-structure interaction problems
[NASA-CR-188018] N91-21729
Implementation of a partitioned algorithm for simulation of large CSI problems
[CU-CSSC-91-4] N91-21730
Parallel computations and control of adaptive structures N91-21732
Learning control of inverted pendulum system by neural network driven fuzzy reasoning: The learning function of NN-driven fuzzy reasoning under changes of reasoning environment N91-21785
Permanent magnet flux-biased magnetic actuator with flux feedback
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CONTROL THEORY

The spacecraft control laboratory experiment optical attitude measurement system
[NASA-TM-102624] N91-21186
Control issues of microgravity vibration isolation N91-21192
Aerospace Applications of Magnetic Suspension Technology, part 2
[NASA-CP-10066-PT-2] N91-21203
Method and apparatus for configuration control of redundant robots
[NASA-CASE-NPO-17801-1-CU] N91-21544
Neural network representation and learning of mappings and their derivatives N91-21780

CONTROLLED ATMOSPHERES

NASA-sponsored containerless processing experiments N91-21335

CONTROLLED FUSION

The Basis version of LASNEX
[DE91-009483] N91-21516
Transport in auxiliary-heated, hot-ion H-mode and L-mode discharges in the DIII-D tokamak
[DE91-008924] N91-21887
Role of the edge electric field and microturbulence in the L-H transition
[DE91-008925] N91-21888

CONTROLLERS

Sliding mode control of magnetic suspensions for precision pointing and tracking applications N91-21193
Magnetic bearings with zero bias N91-21194
A time delay controller for magnetic bearings N91-21205
Experiments in cooperative-arm object manipulation with a two-armed free-flying robot
[NASA-CR-188028] N91-21529
Passive dynamic controllers for nonlinear mechanical systems
[NASA-TM-104047] N91-21573
Active vibration absorber for CSI evolutionary model: Design and experimental results
[NASA-TM-104048] N91-21578
Neural network representation and learning of mappings and their derivatives N91-21780
The simplification of fuzzy control algorithm and hardware implementation N91-21781
Learning control of inverted pendulum system by neural network driven fuzzy reasoning: The learning function of NN-driven fuzzy reasoning under changes of reasoning environment N91-21785

CONVECTION

Cost-effective accurate coarse-grid method for highly convective multidimensional unsteady flows N91-21075
Choice of velocity variables for complex flow computation N91-21076
Computation of turbulent high speed mixing layers using a two-equation turbulence model N91-21084
Levelling of microprofiles in electrodeposition
[DE91-009083] N91-21297
Convective scale dynamics
[AD-A231567] N91-21683

CONVECTIVE FLOW

Cost-effective accurate coarse-grid method for highly convective multidimensional unsteady flows N91-21075

CONVECTIVE HEAT TRANSFER

The direct simulation of high-speed mixing-layers without and with chemical heat release N91-21095
Probability distribution functions in turbulent convection
[NASA-CR-187519] N91-21453

CONVERGENCE

Convergence of the point vortex method for the 3-D Euler equations
[AD-A231285] N91-21479
Rapidly convergent algorithms for nonsmooth optimization
[AD-A231110] N91-21756
Normalized convergence rates for the PSMG method
[AD-A231311] N91-21764
Numerical recovery of certain discontinuous electrical conductivities
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CONVERGENT-DIVERGENT NOZZLES

Static thrust-vectoring performance of nonaxisymmetric convergent-divergent nozzles with post-exit yaw vanes
[NASA-TP-3085] N91-21059
Some treatments on boundary conditions for quasi one-dimensional Euler equations
[FFA-TN-1990-36] N91-21469

CONVEXITY

Interior-point methods for convex programming
[AD-A231372] N91-21765

COOLANTS

Cooling of in-situ propellant rocket engines for Mars mission
[NASA-TM-103729] N91-21233

COOLING

Cooling of in-situ propellant rocket engines for Mars mission
[NASA-TM-103729] N91-21233
Hydrocarbon-fuel/combustion-chamber-liner materials compatibility
[NASA-CR-187104] N91-21307
Thermodynamic properties and crystallization kinetics at high liquid undercooling N91-21343
Undercooling of acoustically levitated molten drops N91-21359

COOLING SYSTEMS

Development of a gas engine-driven chiller
[PB91-130237] N91-21389

COORDINATE TRANSFORMATIONS

Compressible flows with periodic vortical disturbances around lifting airfoils
[NASA-TM-103742] N91-21060

COORDINATES

Method and apparatus for configuration control of redundant robots
[NASA-CASE-NPO-17801-1-CU] N91-21544
Report of the panel on earth rotation and reference frames, section 7 N91-21596

COPOLYMERIZATION

The organic chemistry of conducting polymers
[DE91-009520] N91-21316

COPOLYMERS

Synthesis of imide/arylene ether copolymers for adhesives and composite matrices
[NASA-TM-104067] N91-21306

COPPER

Controlling fundamentals in high-energy high-rate pulsed power materials processing of powdered tungsten, titanium aluminides, and copper-graphite composites
[AD-A230900] N91-21298
Resistance seam welding thin copper foils
[DE91-008988] N91-21535
Dependence of the photorefractive properties of KTa(1-x)Nb(x)O3:Cu,V on Cu valence state concentration
[AD-A230954] N91-21917
Nucleation and growth of diamond on Si, Cu and Au substrates
[AD-A231044] N91-21918

COPPER ALLOYS

CO2 induced inhibition of the localized corrosion of aluminum, Al-0.5 percent Cu, and Al-2 percent Cu in dilute HF solution
[DE91-005312] N91-21292
Hydrocarbon-fuel/combustion-chamber-liner materials compatibility
[NASA-CR-187104] N91-21307

COPPER OXIDES

Structural characterization of the Ag/YBa2Cu3O(7-x) interface
[DE91-009112] N91-21907
Magnetic field induced broadening of the resistive transition in epitaxial films of YBa2Cu3O7 and Y2Ba4Cu8O16
[DE91-009825] N91-21916
Growth and characterization of thin films of Y2O3, La2O3 and La2CuO4
[AD-A231046] N91-21919

COPPER SULFIDES

Hydrocarbon-fuel/combustion-chamber-liner materials compatibility
[NASA-CR-187104] N91-21307

CORN

Use of direct expansion for estimation of soybean and corn areas through multispectral and temporal LANDSAT/TM data
[INPE-5180-PRE/1649] N91-21609

CORRECTION

A pressure based method for the solution of viscous incompressible turbomachinery flows N91-21078
Alignment positioning mechanism
[NASA-CASE-MSC-21502-1] N91-21543
Automatic program correction of interferometry quadratic sensor errors. Application to the processing of signals from a VISAR interferometer
[ISL-R-127/89] N91-21799

CORRELATION

Effects of source correlations on the spectrum of radiated fields
[AD-A230955] N91-21411

CORRELATION DETECTION

Efficient approaches for report/cluster correlation in multitarget tracking systems
[AD-A231589] N91-21421

CORRIDORS

Parametric entry corridors for lunar/Mars aerocapture missions
[NASA-TM-102178] N91-21168

CORROSION

CO2 induced inhibition of the localized corrosion of aluminum, Al-0.5 percent Cu, and Al-2 percent Cu in dilute HF solution
[DE91-005312] N91-21292
In-situ x ray measurements of pit solutions during localized corrosion
[DE91-006916] N91-21295
Hydrocarbon-fuel/combustion-chamber-liner materials compatibility
[NASA-CR-187104] N91-21307

CORROSION PREVENTION

CO2 induced inhibition of the localized corrosion of aluminum, Al-0.5 percent Cu, and Al-2 percent Cu in dilute HF solution
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XANES (X ray Absorption Near Edge Structure) investigation of cerium as an inhibitor for Al alloys
[DE91-005542] N91-21293
A study of the inhibition of pitting of aluminum by chromate
[DE91-006915] N91-21294
Levelling of microprofiles in electrodeposition
[DE91-009083] N91-21297

CORROSION RESISTANCE

Environmentally-induced passivity of aluminum alloys and aluminum metal matrix composites
[AD-A231350] N91-21301

COSMIC BACKGROUND EXPLORER SATELLITE

Early results from the Cosmic Background Explorer (COBE) N91-21988
Early COBE results and superconducting cosmic strings N91-21989
Sub-millimetric cosmology: From ground based to space observations N91-21991
Extragalactic source counts, confusion limits and contributions to the background radiation in the sub-mm N91-21995

COSMIC DUST
Early results from the Cosmic Background Explorer (COBE) N91-21988
Extragalactic source counts, confusion limits and contributions to the background radiation in the sub-mm N91-21995
Millimeter observations of a complete sample of galaxies: Implications for gas mass and cold dust component N91-21999
PRONAOS N91-22020
Submillimeter observations of interstellar dust N91-22028
The 0 deg (63 micron) line emission from galactic high latitude cirrus clouds N91-22029

COSMIC GASES
Submillimeter astronomy and cosmological tests N91-21993

COSMIC NOISE
Sub-millimetric cosmology: From ground based to space observations N91-21991
RELICT 2 project: Scientific program and structure N91-21998

COSMIC RAYS
Theoretical studies in elementary particle physics [DE91-009543] N91-21851
Solar-geophysical data number 553, September 1990. Part 1: (Prompt reports). Data for August 1990, July 1990, and late data [PB91-113019] N91-22059
Multi-core events in cosmic-ray induced interactions with lead at around 10 TeV [DE91-616827] N91-22062
Cosmic Ray Nuclei (CRN) detector investigation [NASA-CR-184137] N91-22063

COSMOLOGY
Theoretical studies in elementary particle physics [DE91-009543] N91-21851
From ground-based to space-borne sub-mm astronomy [ESA-SP-314] N91-21986
Early COBE results and superconducting cosmic strings N91-21989
FIRST: Far Infrared and Submillimeter Space Telescope N91-21990
Sub-millimetric cosmology: From ground based to space observations N91-21991
The microwave background: Its smoothness and frequency distribution as an astrophysical product N91-21992
Submillimeter astronomy and cosmological tests N91-21993
Japanese space programmes of IR and sub-mm astronomy N91-21997
RELICT 2 project: Scientific program and structure N91-21998

COST ANALYSIS
Software development standards for project cost management information system [AD-A231282] N91-21762

COST EFFECTIVENESS
Cost-effective accurate coarse-grid method for highly convective multidimensional unsteady flows N91-21075
Power technologies and the space future [NASA-TM-103649] N91-21240
Threat modernization in the near term [DE91-009228] N91-21817

COST ESTIMATES
Space station: NASA's search for design, cost, and schedule stability continues [GAO/NSIAD-91-125] N91-21187

COTTON
Spectral responses of soybean and cotton from Landsat/TM digital data [INPE-5179-PRE/1648] N91-21614

COUETTE FLOW
General three-dimensional disturbances to inviscid Couette flow [DE91-009593] N91-21474

COUNTERMEASURES
Notes on space, satellites, and survivability [DE91-009229] N91-21226

COUPLING
Electron distortion effects in quasi-elastic electron scattering [DE91-009034] N91-21843

COUPLINGS
Connection space reduction mechanism [NASA-CASE-GSC-13220-1] N91-21525

COVARIANCE
Uncertainty estimates for derivatives and intercepts [DE91-004503] N91-21802

CRACK PROPAGATION
Fracture toughness of unidirectional fiber reinforced ceramic composites in Mode 2 utilizing laser interferometry [AD-A231027] N91-21258
Strength of polymer interfaces [AD-A230839] N91-21318
Contributions to the analysis of the DCB-specimen [FFA-TN-1990-22] N91-21567
Mode 1 interlaminar fracture toughness of carbon/PEEK participation in an international round robin program [FFA-TN-1990-41] N91-21570

CRACKING (FRACTURING)
Transverse cracking in a fiber reinforced ceramic matrix composite [AD-A231029] N91-21259

CRACKS
Contributions to the analysis of the DCB-specimen [FFA-TN-1990-22] N91-21567

CREEP PROPERTIES
Engineering property limitations of structural ceramics and ceramic composites above 1600 C [DE91-009105] N91-21311
Integrated synthesis and post processing of silicon carbide and aluminum nitride [AD-A230810] N91-21317
Superplastic creep of eutectic tin-lead solder joints [DE91-009074] N91-21586

CREEP STRENGTH
A simple test for thermomechanical evaluation of ceramic fibers [NASA-TM-103767] N91-21309

CRITERIA
A criterion for the optimal design of multi-axis force sensors [AD-A231014] N91-21500
Thermal buckling and postbuckling of symmetrically laminated composite plates [NASA-CR-188030] N91-21560

CRITICAL PRESSURE
Supercritical microgravity droplet vaporization N91-21354

CRITICAL TEMPERATURE
Supercritical microgravity droplet vaporization N91-21354

CRITICAL VELOCITY
Critical speeds and forced response solutions for active magnetic bearing turbomachinery, part 1 N91-21209
Critical speeds and forced response solutions for active magnetic bearing turbomachinery, part 2 N91-21210

CROP IDENTIFICATION
Evaluation of TM/LANDSAT-5 bands in the discrimination of wheat and beam crops [INPE-5204-PRE/1666] N91-21602
Use of direct expansion for estimation of soybean and corn areas through multispectral and temporal LANDSAT/TM data [INPE-5180-PRE/1649] N91-21609

CROP INVENTORIES
Use of direct expansion for estimation of soybean and corn areas through multispectral and temporal LANDSAT/TM data [INPE-5180-PRE/1649] N91-21609

CROP VIGOR
TM/LANDSAT-5 multispectral reflectance for the remote sensing of the condition of bean crop vigor [INPE-5184-PRE/1652] N91-21604

CRYOGENIC COOLING
Evaluation of bearing configurations using the single bearing tester in liquid nitrogen [NASA-TM-103527] N91-21532
The MPE/UCB Far-Infrared imaging Fabry-Perot Interferometer (FIFI) N91-22005
Radiatively-cooled telescopes for infrared space astronomy N91-22048

CRYOGENICS
Reduction in bearing size due to superconductors in magnetic bearings N91-21211

CRYSTAL DEFECTS
High temperature deformation of silicon [DE91-009102] N91-21305

CRYSTAL DISLOCATIONS
Deformation substructures induced by high-rate deformation [DE91-008595] N91-21288
EBIC (Electron Beam Induced Current) contrast of clean, decorated and deuterium passivated Si(Ge) epitaxial misfit dislocations [DE91-006967] N91-21912

CRYSTAL GROWTH
Zeolites in space N91-21165
The nucleation and growth of polycrystalline silicon carbide [DE91-008887] N91-21304
TEMPUS: First results N91-21350
Multiple sensor multifrequency eddy current monitor for solidification and growth N91-21362
An examination of anticipated g-jitter on space station and its effects on materials processes [NASA-TM-103775] N91-21378
On the crystal structure of boron carbides [DE91-009256] N91-21914
Nucleation and growth of diamond on Si, Cu and Au substrates [AD-A231044] N91-21918
Kinetic aspects of lattice mismatch in molecular beam epitaxial growth on planar and patterned substrates [AD-A231636] N91-21934

CRYSTAL LATTICES
Kinetic aspects of lattice mismatch in molecular beam epitaxial growth on planar and patterned substrates [AD-A231636] N91-21934

CRYSTAL STRUCTURE
Deformation substructures induced by high-rate deformation [DE91-008595] N91-21288
Organic aerogels: A new type of ultrastructured polymer [DE91-008500] N91-21312
Grain boundaries [DE91-007932] N91-21905
Pressure dependence of deep centers by capacitance spectroscopies inside the diamond anvil cell [DE91-008927] N91-21906
On the crystal structure of boron carbides [DE91-009256] N91-21914
Interplay between local environment effect and electronic structure properties in close packed structures [DE91-008506] N91-21915
An investigation of Si-SiO2 interface charges in thermally oxidated (100), (110), (111), (511) silicon [AD-A231244] N91-21923
Magnetic quasicrystals [AD-A231264] N91-21924
Host materials for 4d(sup N) and 5d(sup N) transition-metal ions [AD-A231606] N91-21933

CRYSTAL SURFACES
The nucleation and growth of polycrystalline silicon carbide [DE91-008887] N91-21304

CRYSTALLINITY
Formation of controlled adiabatic shear bands in AISI 4340 high strength steel [AD-A230999] N91-21300
Thermodynamic properties and crystallization kinetics at high liquid undercooling N91-21343

CRYSTALLIZATION
Thermodynamic properties and crystallization kinetics at high liquid undercooling N91-21343
Finding a single molecule in a haystack: Laser spectroscopy of solids from square root of (N to N) = 1 [AD-A230910] N91-21521

CRYSTALS
Tractable high performance polymers [AD-A231072] N91-21320
Observation of spectral diffusion in crystals using single impurity molecules [AD-A231338] N91-21926

CUBIC EQUATIONS
A method for the geometrically nonlinear analysis of compressively loaded prismatic composite structures [NASA-CR-184846] N91-21561

CULTURE TECHNIQUES
Rotating bio-reactor cell culture apparatus [NASA-CASE-MSC-21293-1] N91-21700
Spiral vane bioreactor [NASA-CASE-MSC-21361-1] N91-21701

CURING
UV cured epoxy resin coatings [DE91-008180] N91-21303
An evaluation of the effects of varying composition and processing on several encapsulating resins [DE91-009101] N91-21314

CURRENT DENSITY
Reduction in bearing size due to superconductors in magnetic bearings N91-21211

CURRENT DISTRIBUTION
Levelling of microprofiles in electrodeposition [DE91-009083] N91-21297

CURVATURE
Numerical investigation of an internal layer in turbulent flow over a curved hill N91-21083

CURVED PANELS
Impact damage in curved graphite/epoxy panels with clamped edges [AD-A230853] N91-21257

CYANO COMPOUNDS
Undercooling of acoustically levitated molten drops N91-21359

CYCLONES
Tropical cyclone track objective aids for the microcomputer: PCLM, XTRP, PCHP [AD-A230851] N91-21675

ONR tropical cyclone motion research initiative: Field experiment summary
[AD-A231152] N91-21679
Experiment on rapidly intensifying cyclones over the Atlantic
[AD-A231377] N91-21682
CYCLOTRON RADIATION
Quasilinear simulation of auroral kilometric radiation by a relativistic Fokker-Planck code
[DE91-009736] N91-21656
CYCLOTRONS
Quasilinear simulation of auroral kilometric radiation by a relativistic Fokker-Planck code
[DE91-009736] N91-21656
CYLINDERS
Computer program for the calculation of normal force and pitching moment of forebody-cylinder combinations at angles of attack up to 90 degrees and Mach numbers up to 5, including effects of conical boat-tailing
[ESDU-90034] N91-21102
CYLINDRICAL BODIES
Coning motion of slender bodies at high angles of attack
[NAL-TR-1059] N91-21111
CYLINDRICAL SHELLS
Large deformation behavior of long shallow cylindrical composite panels
[NASA-CR-4355] N91-21557
CYTOLOGY
Spiral vane bioreactor
[NASA-CASE-MSC-21361-1] N91-21701

D

DAMAGE
The micrometeoroid impact hazard in space: Techniques for damage simulation by pulsed lasers and environmental modelling N91-21220
On-orbit damage detection and health monitoring of large space trusses: Status and critical issues
[NASA-TM-104045] N91-21579
DAMAGE ASSESSMENT
Model correlation and damage location for large space truss structures: Secant method development and evaluation
[NASA-CR-188102] N91-21213
Model rocketry hazard study
[DOT/FAA/CT-TN90/28] N91-21238
Impact damage in curved graphite/epoxy panels with clamped edges
[AD-A230853] N91-21257
Dynamics of vegetation and soils of oak/saw palmetto scrub after fire: Observations from permanent transects
[NASA-TM-103817] N91-21635
Features of the Raleigh tornadic storm based on analysis of damage
[AD-A231601] N91-21684
DAMPING
Surface tension and viscosity from damped free oscillations of viscous droplets N91-21346
Closed-form solutions for linear regulator design of mechanical systems including optimal weighting matrix selection
[NASA-TM-104052] N91-21572
A fully Galerkin method for the recovery of stiffness and damping parameters in Euler-Bernoulli beam models
[NASA-CR-187517] N91-21796
ICRF heating in reactor grade plasmas
[DE91-005491] N91-21886
Observation of parallel viscosity in the CHS heliotron/torsatron
[NIFS-70] N91-21891
DARK MATTER
Indirect detection of heavy supersymmetric dark matter
[DE91-009669] N91-22055
DATA ACQUISITION
Study of bird ingestions into small inlet area aircraft turbine engines
[DOT/FAA/CT-90/13] N91-21122
Survey of NCAR user needs for visualization tools. A research report of the Digital/NCAR joint research project
[PB91-115444] N91-21154
Attitude control simulation of the data collecting satellite: SCD2
[INPE-5159-PRE/1638] N91-21218
Enhanced selectivity and detectability in absorption and fluorescence methods based on polarization modulation
[DE91-008926] N91-21279
Test results of a 90 MHz integrated circuit sixteen channel analog pipeline for SSC detector calorimetry
[DE91-009773] N91-21436
Physiology data acquisition system description
[AD-A231088] N91-21706
Signal parameter algorithms for trend analysis of digital data acquisition systems
[DE91-008171] N91-21749
Uncertainty estimates for derivatives and intercepts
[DE91-004503] N91-21802
DATA BASE MANAGEMENT SYSTEMS
Automated computer software development standards enforcement
[DE91-007328] N91-21748
SEPEC conference proceedings: Hypermedia and Infromation Reconstruction. Aerospace applications and research directions
[NASA-CR-187935] N91-21940
GERM as a tool for space station documentation N91-21950
Hypermedia as medium N91-21952
Access and operator methods for the Triton nested relational database system
[AD-A230608] N91-21962
Relational databases with NIAM models bid so long to top-down designs
[DE91-009191] N91-21965
Data element dictionary: Technical report database, part 1
[AD-A230836] N91-21969
DATA BASES
Survey of NCAR user needs for visualization tools. A research report of the Digital/NCAR joint research project
[PB91-115444] N91-21154
AEOSS design guide for system analysis on Advanced Earth-Orbital Spacecraft Systems
[NASA-TM-100772] N91-21223
AEOSS runtime manual for system analysis on Advanced Earth-Orbital Spacecraft Systems
[NASA-TM-100773] N91-21224
The mechanical property data base from an Air Force/industry cooperative test program on advanced aluminum alloys (8090 extrusion)
[AD-A230903] N91-21299
Extended database of microwave common carrier antenna gain patterns
[PB91-119206] N91-21398
A digital data bank for geological exploration in the mining belt of the Pojuca (Carajas) Cu-Zn deposit, based on geological, geochemical, remote sensing, and elevation data
[INPE-5172-PRE/1641] N91-21617
Design and development of the terrain information extraction system
[AD-A231166] N91-21623
The hemispheric eighth mesh terrain elevation and geography data sets
[AD-A231592] N91-21624
Geodynamics branch data base for main magnetic field analysis
[NASA-TM-104542] N91-21653
An annotated bibliography of hypobaric decompression sickness research conducted at the Crew Technology Division, USAF School of Aerospace Medicine, Brooks AFB, Texas from 1983 to 1988
[AD-A231355] N91-21710
IDEAL, a dialogic interface in a natural language for expert systems
[INPE-5151-TDL/424] N91-21742
An empirical evaluation of analytical models for parallel relational database queries
[AD-A230813] N91-21752
The object the metaphor the power and evergreen or the eighth way to make a hypermedia project fail N91-21947
From knowledge presentation to knowledge representation to knowledge construction: Future directions for hypermedia N91-21954
AiGERM: A logic programming front end for GERM N91-21957
Access and operator methods for the Triton nested relational database system
[AD-A230608] N91-21962
Data element dictionary: Technical report database, part 1
[AD-A230836] N91-21969
Source header list. Volume 1: A through K
[AD-A231000] N91-21971
Source header list. Volume 2: L through Z
[AD-A231001] N91-21972
DATA COLLECTION PLATFORMS
Design of a processing facility for synthetic aperture radar data at the Tromso ERS-1 ground station N91-21161
DATA CORRELATION
Intercomparison of the chemical and meteorological data generated from aircraft and shipboard sampling during GCE/CASE/WATOX
[PB91-129098] N91-21667
DATA FLOW ANALYSIS
Specification of the autonomous missile guidance problem for the TA11 processor. Volume 4: Processor mini-spec
[FFI-90/4005-VOL-4] N91-21145
Specification of the autonomous missile guidance problem for the TA11 processor. Volume 6: Specification mode 16, N
[FFI-90/4005-VOL-6] N91-21146
Specification of the autonomous missile guidance problem for the TA11 processor. Volume 7: Specification mode 29, N + A + T + H
[FFI-90/4005-VOL-7] N91-21147
Specification of the autonomous missile guidance problem for the TA11 processor. Volume 8: Specification mode 30, N + A + T + B
[FFI-90/4005-VOL-8] N91-21148
DATA INTEGRATION
Data integration of different sensor systems through the technique of IHS transformation, the purpose and study of intra-urban structure
[INPE-5171-PRE/1640] N91-21616
DATA LINKS
Long-term performance and propagation measurements on single and tandem digital microwave transmission links. Volume 2: Appendixes
[PB91-129650] N91-21397
DATA MANAGEMENT
Experiment Document Information System (EDIS) evolution N91-21941
Engineering software development with HyperCard N91-21942
Seven ways to make a hypertext project fail N91-21946
The object the metaphor the power and evergreen or the eighth way to make a hypermedia project fail N91-21947
Automating hypertext for decision support N91-21951
Hypermedia as medium N91-21952
Hypermedia = hypercommunication N91-21953
SEPEC conference proceedings: Hypermedia and Information Reconstruction. Aerospace applications and research directions. Addendum
[NASA-CR-187936] N91-21955
HEAVENS system for software artifacts N91-21958
Scan-line methods in spatial data systems
[AD-A231165] N91-21973
DATA PROCESSING
Specification of the autonomous missile guidance problem for the TA11 processor. Volume 4: Processor mini-spec
[FFI-90/4005-VOL-4] N91-21145
Specification of the autonomous missile guidance problem for the TA11 processor. Volume 6: Specification mode 16, N
[FFI-90/4005-VOL-6] N91-21146
Specification of the autonomous missile guidance problem for the TA11 processor. Volume 7: Specification mode 29, N + A + T + H
[FFI-90/4005-VOL-7] N91-21147
Specification of the autonomous missile guidance problem for the TA11 processor. Volume 8: Specification mode 30, N + A + T + B
[FFI-90/4005-VOL-8] N91-21148
Implementation of FFT and pulse compression routines on the SPT frequency domain array processor
[AD-A231320] N91-21443
A research program in computer technology
[AD-A231025] N91-21727
Experience with abstract notation one
[NASA-CR-188090] N91-21741
Using fuzzy logic to integrate neural networks and knowledge-based systems N91-21788
Uncertainty estimates for derivatives and intercepts
[DE91-004503] N91-21802
Promoting a healthy skepticism with regard to information processing
[DE91-007697] N91-21968
DATA REDUCTION
GRESS: A preprocessor for sensitivity studies on FORTRAN programs
[DE91-009561] N91-21751
DATA SAMPLING
Digital signal conditioning for flight test instrumentation
[NASA-TM-101739] N91-21135
Bayesian analysis of constrained parameter and truncated data problems
[AD-A231080] N91-21810
DATA STORAGE
Digital signal conditioning for flight test instrumentation
[NASA-TM-101739] N91-21135
DATA SYSTEMS
Scan-line methods in spatial data systems
[AD-A231165] N91-21973

DATA TRANSFER (COMPUTERS)
Issues in providing a reliable multicast facility
[NASA-CR-188089] N91-21403
DATA TRANSMISSION
Digital signal conditioning for flight test instrumentation
[NASA-TM-101739] N91-21135
Issues in providing a reliable multicast facility
[NASA-CR-188089] N91-21403
Performance characteristics of Mach-Zehnder modulators for transfer of detector signals by optical fibers
[DE91-008439] N91-21873
DECISION MAKING
Decision support environment for concurrent engineering requirements
[AD-A230899] N91-21555
Proceedings of the Second Joint Technology Workshop on Neural Networks and Fuzzy Logic, volume 1
[NASA-CP-10061-VOL-1] N91-21778
Single board system for fuzzy inference N91-21784
Acquisition and production of skilled behavior in dynamic decision-making tasks
[NASA-CR-188084] N91-21939
Automating hypertext for decision support N91-21951
DECOMPOSITION
Domain decomposition methods in computational fluid dynamics
[NASA-CR-187529] N91-21457
DECOMPRESSION SICKNESS
An annotated bibliography of hypobaric decompression sickness research conducted at the Crew Technology Division, USAF School of Aerospace Medicine, Brooks AFB, Texas from 1983 to 1988
[AD-A231355] N91-21710
DECOUPLING
On the anomaly of velocity-pressure decoupling in collocated mesh solutions
[NASA-TM-103769] N91-21448
DEEP WATER
Singularities in water waves and Rayleigh-Taylor instability
[NASA-CR-187530] N91-21455
DEFECTS
Contributions of conformational and structural defects to the hyper-polarizabilities of polymers
[DE91-009042] N91-21313
An economic analysis of counterfeit threaded fasteners in the construction industry
[AD-A231492] N91-21551
A method for the geometrically nonlinear analysis of compressively loaded prismatic composite structures
[NASA-CR-184846] N91-21561
DEFENSE INDUSTRY
Top quality management, reliability, and maintainability: Institutional goals with built in barriers
[AD-A230134] N91-21552
DEFENSE PROGRAM
Strategic defense system: Stable design and adequate testing must precede decision to deploy
[AD-A230864] N91-21820
Source header list. Volume 1: A through K
[AD-A231000] N91-21971
Source header list. Volume 2: L through Z
[AD-A231001] N91-21972
DEFLAGRATION
On the dynamics of the combustion process of hydrogen-air and hydrogen-methane-air mixtures
[ESA-TT-1198] N91-21268
DEFLECTION
Bifurcation analysis of the longitudinal dynamics of a simple powered lifting hypersonic vehicle
[AD-A230826] N91-21118
DEFORESTATION
Characterization of antropic action in the Mearim (MA) middle-low valley through LANDSAT/TM imagery
[INPE-5075-PRE/1594] N91-21620
DEFORMATION
Formation of controlled adiabatic shear bands in AISI 4340 high strength steel
[AD-A230999] N91-21300
High temperature deformation of silicon
[DE91-009102] N91-21305
Large deformation behavior of long shallow cylindrical composite panels
[NASA-CR-4355] N91-21557
Update of PRONTO 2D and PRONTO 3D transient solid dynamics program
[DE91-009183] N91-21564
Report of the panel on plate motion and deformation, section 2 N91-21591
DEGRADATION
Impact of icing on Unmanned Aerial Vehicle (UAV) operations
[AD-A231191] N91-21124
Space vehicle propulsion systems: Environmental space hazards
[NASA-CR-188094] N91-21236
Report of the panel on the land surface: Process of change, section 5 N91-21594
DEGREES OF FREEDOM
Five degree-of-freedom control of an ultra-precision magnetically-suspended linear bearing N91-21196
DELAMINATING
Delamination and free edge stresses in laminated plates subjected to constant uniaxial strain (computer program)
[ESDU-90021] N91-21253
DELIVERY
Evaluation of an alternative rotorcraft cargo lowering device for the delivery of 500-lb ammunition loads
[AD-A230995] N91-21133
DELTA WINGS
Vortex bursting over a unit area aspect ratio delta wing using vortex paneling methods
[AD-A231028] N91-21119
DEMODULATION
SAW technology for multicarrier demodulation in advanced payloads N91-21164
DEMOGRAPHY
Physical property measurements on analog granites related to the joint verification experiment
[AD-A230571] N91-21650
DENITROGENATION
Control of catalytic hydrotreating selectivity with ammonia
[DE91-008405] N91-21272
DENSITY MEASUREMENT
Nonintrusive nitric oxide density measurements in the NASA Langley arc-heated scramjet engine test facility
[AD-A231260] N91-21142
DEPENDENT VARIABLES
Choice of velocity variables for complex flow computation N91-21076
DEPLOYMENT
Effectiveness of bomber deployed autonomous airborne vehicles in finding rail mobile SS-24s
[DE91-009008] N91-21815
DEPOSITION
Chemical spray pyrolysis of Tl-Ba-Ca-Cu-O high-T(sub c) superconductors for high-field bitter magnets N91-21212
Adaptation of the Advanced Statistical Trajectory Regional Air Pollution (ASTRAP) model to the EPA VAX computer: Modifications and testing
[PB91-127720] N91-21631
DEPTH MEASUREMENT
WINTER 1990 hydrographics data report: CTD station profiles, sections, nutrients, SAIL, January - February 1990
[DE91-008286] N91-21686
DESIGN ANALYSIS
A highly efficient engineering tool for three-dimensional scramjet flowfield and heat transfer computations N91-21098
Shuttle Entry Air Data System (SEADS) hardware development. Volume 1: Summary
[NASA-CR-166044-VOL-1] N91-21179
Shuttle Entry Air Data System (SEADS) hardware development. Volume 2: History
[NASA-CR-166044-VOL-2] N91-21180
A new fabrication method for precision antenna reflectors for space flight and ground test
[NASA-TP-3078] N91-21185
Control issues of microgravity vibration isolation N91-21192
Magnetic suspension and balance system advanced study, 1989 design N91-21197
AEOSS design guide for system analysis on Advanced Earth-Orbital Spacecraft Systems
[NASA-TM-100772] N91-21223
AEOSS runtime manual for system analysis on Advanced Earth-Orbital Spacecraft Systems
[NASA-TM-100773] N91-21224
Large liquid rocket engine transient performance simulation system
[NASA-CR-184099] N91-21232
Estimating power amplifier large signal gain
[AD-A230823] N91-21437
Transverse klystron
[AD-A231586] N91-21444
HITCAN for actively cooled hot-composite thermostructural analysis
[NASA-TM-103750] N91-21562
Closed-form solutions for linear regulator design of mechanical systems including optimal weighting matrix selection
[NASA-TM-104052] N91-21572
Scattering in the time domain from submerged elastic shells at coincidence frequencies
[AD-A231122] N91-21837
DESIGN TO COST
Space station: NASA's search for design, cost, and schedule stability continues
[GAO/NSIAD-91-125] N91-21187
DESORPTION
Applications and current limitations of matrix-assisted laser desorption Fourier transform mass spectrometry for biomolecules
[DE91-008877] N91-21265
Rapid determination of drugs and semivolatile organics by direct thermal desorption ion trap mass spectrometry
[DE91-008885] N91-21278
DESTRUCTION
The production and destruction of negative ions
[DE91-009517] N91-21850
DETECTION
Preliminary field demonstration of a fiber-optic TCE sensor
[DE91-008453] N91-21498
On-orbit damage detection and health monitoring of large space trusses: Status and critical issues
[NASA-TM-104045] N91-21579
Gust front/wind shift detection algorithm for the terminal Doppler weather radar
[DOT/FAA/NR-91/4] N91-21671
Effectiveness of bomber deployed autonomous airborne vehicles in finding rail mobile SS-24s
[DE91-009008] N91-21815
Adaptive detection in subspaces
[AD-A231023] N91-21876
Characteristic x rays method for detecting cold fusion
[DE91-619982] N91-21890
Coherent and incoherent detection N91-22010
Indirect detection of heavy supersymmetric dark matter
[DE91-009669] N91-22055
DETONATION
On the dynamics of the combustion process of hydrogen-air and hydrogen-methane-air mixtures
[ESA-TT-1198] N91-21268
DETONATION WAVES
Uniform high order spectral methods for one and two dimensional Euler equations
[NASA-CR-187535] N91-21456
DEUTERIUM
Colorado School of Mines fusion gamma ray diagnostic project
[DE91-009259] N91-21889
Characteristic x rays method for detecting cold fusion
[DE91-619982] N91-21890
DEW POINT
Wet atmospheric generation apparatus
[NASA-CASE-MFS-28177-1] N91-21496
DIAMONDS
Artifact diamond characterization
[AD-A231555] N91-21323
Beam line and associated work
[AD-A231243] N91-21867
Pressure dependence of deep centers by capacitance spectroscopies inside the diamond anvil cell
[DE91-008927] N91-21906
Nucleation and growth of diamond on Si, Cu and Au substrates
[AD-A231044] N91-21918
The effect of microstructure on the thermal conductivity of ZnS/diamond composites
[AD-A231349] N91-21928
DIAPHRAGMS (MECHANICS)
Flexible diaphragm-extreme temperature usage
[NASA-CASE-MSC-20797-2] N91-21494
DICHROISM
Enhanced selectivity and detectability in absorption and fluorescence methods based on polarization modulation
[DE91-008926] N91-21279
Ab initio study of the electric dipole transition moment for the electronic X to C transition in acetylene: Theoretical predictions of the absorption and magnetic circular dichroism intensities
[AD-A231227] N91-21442
DICTIONARIES
Data element dictionary: Technical report database, part 1
[AD-A230836] N91-21969
DIESEL ENGINES
Spark-ignited diesel engine
[AD-A230243] N91-21533
DIFFERENTIAL EQUATIONS
On the application of ENO scheme with subcell resolution to conservation laws with stiff source terms N91-21074
Uniform high order spectral methods for one and two dimensional Euler equations
[NASA-CR-187535] N91-21456
Asymptotic integration algorithms for nonhomogeneous, nonlinear, first order, ordinary differential equations
[NASA-TM-103793] N91-21797

DIFFRACTION
Serrated circular apertures: Optical Fourier transforms and fractal analysis
[AD-A230834] N91-21874
Dependence of the photorefractive properties of KTa(1-x)Nb(x)O3:Cu,V on Cu valence state concentration
[AD-A230954] N91-21917
DIFFUSE RADIATION
Analysis and interpretation of diffuse x-ray emission using data from the Einstein satellite
[NASA-CR-187988] N91-21728
A millimeter and submillimeter balloon telescope for measurements of diffuse radiation N91-22040
DIFFUSERS
Evaluation of air injection in a sudden expansion diffuser for real-time afterburning application
[AD-A230850] N91-21141
DIFFUSION
User's manual for SLAB: An atmospheric dispersion model for denser-than-air-releases
[DE91-008443] N91-21638
Diffusive transport enhancement by isolated resonances and distribution tails growth in hadronic beams
[DE91-006379] N91-21864
Grain boundaries
[DE91-007932] N91-21905
DIFFUSION WAVES
Thermal transport studies of optical coatings, interfaces and surfaces by thermal diffusion-wave interferometry
[AD-A231607] N91-21879
DIFFUSIVITY
Flux-vector splitting for the 1990s N91-21073
DIGITAL COMPUTERS
Digital signal conditioning for flight test instrumentation
[NASA-TM-101739] N91-21135
Digital optical computer global interconnect algorithm study
[AD-A230282] N91-21736
DIGITAL DATA
Discrimination of lithological units in the lower Valley of the Curaca River (Bahia), through enhancement of digital processing of MSS-LANDSAT-3 data
[INPE-5120-RPE/627] N91-21613
Spectral responses of soybean and cotton from Landsat/TM digital data
[INPE-5179-PRE/1648] N91-21614
A digital data bank for geological exploration in the mining belt of the Pojuca (Carajas) Cu-Zn deposit, based on geological, geochemical, remote sensing, and elevation data
[INPE-5172-PRE/1641] N91-21617
Signal parameter algorithms for trend analysis of digital data acquisition systems
[DE91-008171] N91-21749
DIGITAL ELECTRONICS
Silicon hybrid Wafer Scale Integration (WSI) used to fabricate a Hilbert transform integrated circuit module
[AD-A230605] N91-21428
Phase-lock-loop application for fiber optic receiver
[NASA-TM-102776] N91-21435
DIGITAL NAVIGATION
Tactical Environmental Support System (TESS(3)) satellite cloud analyses
[AD-A231247] N91-21681
DIGITAL SIMULATION
Identification of parameters derived from inertial sensors
[INPE-5166-RPE/637] N91-21746
DIGITAL SYSTEMS
Analysis of 200 Hz CW tone propagation signal recorded during the September 1987 VLA experiment
[AD-A231053] N91-21414
Test generation for digital circuits using parallel processing
[AD-A231006] N91-21440
A preliminary evaluation of an F100 engine parameter estimation process using flight data
[NASA-TM-4216] N91-21446
Design and development of the terrain information extraction system
[AD-A231166] N91-21623
Knowledge base systems in DMA's digital production system
[AD-A230771] N91-21963
Scan-line methods in spatial data systems
[AD-A231165] N91-21973
DIGITAL TECHNIQUES
Digital signal conditioning for flight test instrumentation
[NASA-TM-101739] N91-21135
DIPOLE MOMENTS
Ab initio study of the electric dipole transition moment for the electronic X to C transition in acetylene: Theoretical predictions of the absorption and magnetic circular dichroism intensities
[AD-A231227] N91-21442
DIPPING
Dip coating of sol-gels
[DE91-007571] N91-21872
DIRAC EQUATION
Electron distortion effects in quasi-elastic electron scattering
[DE91-009034] N91-21843
DIRECT CURRENT
A new, simple electrostatic-acoustic hybrid levitator N91-21369
Principle, advantages and disadvantages of a dc Current Transformer (DCCT)
[DIGEL-1990-5] N91-21431
DIRECT LIFT CONTROLS
Impact of icing on Unmanned Aerial Vehicle (UAV) operations
[AD-A231191] N91-21124
DIRECTIONAL ANTENNAS
Real time assisted tracking for low Earth orbit satellites
[INPE-5157-PRE/1636] N91-21170
DIRECTIONAL CONTROL
Dynamic modelling and analysis of a magnetically suspended flexible rotor N91-21208
DIRECTIONAL SOLIDIFICATION (CRYSTALS)
Experiments for electromagnetic levitation in microgravity N91-21348
DIRICHLET PROBLEM
On the slowness of phase boundary motion in one space dimension
[AD-A231286] N91-21480
DISASTERS
Materials can be stressed out too
[AD-A231351] N91-21589
DISCONTINUITY
On the application of ENO scheme with subcell resolution to conservation laws with stiff source terms N91-21074
On one-sided filters for spectral Fourier approximations of discontinuous functions
[NASA-CR-187541] N91-21801
DISEASES
International document on food irradiation
[DE91-615879] N91-21715
DISK GALAXIES
Submillimeter astronomy and low mass star formation N91-22012
DISPERSING
Report of the panel on volcanology, section 4 N91-21593
DISPLAY DEVICES
Graphical user interfaces in computational chemistry
[DE91-009116] N91-21267
A system for the real-time display of radar and video images of targets
[NASA-CR-188058] N91-21394
A remote visual interface tool for simulation control and display
[AD-A231019] N91-21754
Enhanced single layer multi-color or luminescent display with coactivators
[NASA-CASE-LAR-14181-1] N91-21911
DISTORTION
Compressible flows with periodic vortical disturbances around lifting airfoils
[NASA-TM-103742] N91-21060
DISTRIBUTED PROCESSING
The software system on parallel processor for computational fluid dynamics N91-21388
Tools for monitoring and controlling distributed applications
[NASA-CR-188034] N91-21770
Intelligent array system
[AD-A231107] N91-21792
DISTRIBUTION FUNCTIONS
Transport via moments of quantum distribution functions
[AD-A231182] N91-21821
DIVERGENT NOZZLES
Some treatments on boundary conditions for quasi one-dimensional Euler equations
[FFA-TN-1990-36] N91-21469
DIVERTERS
Spectral analysis of the heliotron field with the toroidal harmonic function in a study of the structure of built-in divertor
[NIFS-71] N91-21892
DMSP SATELLITES
Cloud classification of DMSP visible and IR imagery using physical and textural features
[AD-A231186] N91-21680
DOCUMENTATION
Experiment Document Information System (EDIS) evolution N91-21941
GERM as a tool for space station documentation N91-21950
DOCUMENTS
Transportation telecommunications
[PB91-123257] N91-21399
Experiment Document Information System (EDIS) evolution N91-21941
DOPED CRYSTALS
Nonlinear optical spectroscopy of Ce3(+) ions in insulating crystals
[DE91-008928] N91-21913
DOPPLER EFFECT
Estimations of ABL fluxes and other turbulence parameters from Doppler lidar data
[NASA-CR-188062] N91-21648
Recent developments in Monte Carlo techniques
[DE91-009750] N91-21808
Studies of synchrotron radiation emission from the NRL modified betatron accelerator
[AD-A231346] N91-21868
DOPPLER RADAR
Estimations of ABL fluxes and other turbulence parameters from Doppler lidar data
[NASA-CR-188053] N91-21665
Gust front/wind shift detection algorithm for the terminal Doppler weather radar
[DOT/FAA/NR-91/4] N91-21671
DRAG
Impact of icing on Unmanned Aerial Vehicle (UAV) operations
[AD-A231191] N91-21124
Frictional and retarding forces on aircraft tyres. Part 5: Estimation of fluid drag forces
[ESDU-90035] N91-21537
DRAG REDUCTION
Materials for aerospace vehicles friction drag reduction surfaces
[INPE-5188-PRE/1656] N91-21217
DRAINAGE
Dynamics of vegetation and soils of oak/saw palmetto scrub after fire: Observations from permanent transects
[NASA-TM-103817] N91-21635
DRIFT (INSTRUMENTATION)
Identification of parameters derived from inertial sensors
[INPE-5166-RPE/637] N91-21746
DRONE AIRCRAFT
Impact of icing on Unmanned Aerial Vehicle (UAV) operations
[AD-A231191] N91-21124
DROP SIZE
Comparison of UNL laser imaging and sizing system and a phase Doppler system for analyzing sprays from a NASA nozzle
[NASA-CR-185239] N91-21485
DROP TESTS
Containerless processing projects N91-21336
The Japanese containerless experiments N91-21338
DROP TOWERS
NASA-sponsored containerless processing experiments N91-21335
DROPS (LIQUIDS)
Spray combustion modeling and evaluation
[DE91-007923] N91-21264
Containerless processing projects N91-21336
Surface tension and viscosity from damped free oscillations of viscous droplets N91-21346
Containerless protein crystal growth technology: Electrostatic multidrop positioner N91-21352
Supercritical microgravity droplet vaporization N91-21354
Using a microgravity environment to probe wave turbulence N91-21355
Drop evaporation in a single-axis acoustic levitator N91-21356
Rheological properties, shape oscillations, and coalescence of liquid drops with surfactants N91-21357
Optical scattering methods applicable to drops and bubbles N91-21358
Undercooling of acoustically levitated molten drops N91-21359
Feedback controlled electrostatic and electromagnetic sample positioners N91-21370
Drop coalescence studies N91-21375
Center for low-gravity fluid mechanics and transport phenomena
[NASA-CR-188048] N91-21452
User's manual for SLAB: An atmospheric dispersion model for denser-than-air-releases
[DE91-008443] N91-21638
Theoretical investigation of the injection and evaporation of water in a hydrogen/oxygen steam generator
[DLR-FB-90-20] N91-21938
DRUGS
Rapid determination of drugs and semivolatile organics by direct thermal desorption ion trap mass spectrometry
[DE91-006885] N91-21278

DUCTED FLOW
An experimental comparison of nonswirling and swirling flow in a circular-to-rectangular transition duct
[NASA-TM-104359] N91-21115
DUCTS
An experimental comparison of nonswirling and swirling flow in a circular-to-rectangular transition duct
[NASA-TM-104359] N91-21115
DUMP COMBUSTORS
Computational modelling of dump combustors flowfield N91-21096
DURABILITY
Constant-current stagnation-point film-anemometer probe
[AD-A231048] N91-21501
DUST
Climatic impact of volcanic eruptions N91-21643
Submillimetre photometry of comets N91-22052
DYE LASERS
The theory of temporal compression of intense pulses in a metal vapor
[DE91-005059] N91-21509
Amplification of femtosecond pulses using a N2 pump laser
[DE91-008413] N91-21513
Statistical fluctuations in lasers
[DE91-009540] N91-21517
DYNAMIC CHARACTERISTICS
Rotary-balance testing for aircraft dynamics
[AGARD-AR-265] N91-21156
Effects of gear box vibration and mass imbalance on the dynamics of multi-stage gear transmissions
[NASA-TM-103695] N91-21534
Chaotic spectra of small molecules
[AD-A231638] N91-21859
DYNAMIC CONTROL
Dynamic and control assessment of the Space Station Freedom payload pointing system
[NASA-TM-101667] N91-21225
Experiments in cooperative-arm object manipulation with a two-armed free-flying robot
[NASA-CR-188028] N91-21529
DYNAMIC LOADS
Method and apparatus for detecting laminar flow separation and reattachment
[NASA-CASE-LAR-13952-2-SB] N91-21472
DYNAMIC MODELS
Dynamic modelling and analysis of a magnetically suspended flexible rotor N91-21208
Dynamics of oceanic motions
[AD-A231135] N91-21693
Objective use of satellite altimetry and IR in simulations of western boundary current dynamics
[AD-A231628] N91-21695
High performance computing for large eddy simulations: Today and tomorrow
[AD-A231220] N91-21758
Chaotic and random processes
[DE91-008574] N91-21804
DYNAMIC PRESSURE
Span reduction effects on the flutter characteristics of arrow-wing supersonic transport configurations
[NASA-TP-3077] N91-21127
DYNAMIC PROGRAMMING
Speech recognition using Kohonen neural networks, dynamic programming, and multi-feature fusion
[AD-A230951] N91-21410
DYNAMIC RESPONSE
Structures of non-circular cross-section: Dynamic response due to vortex shedding
[ESDU-90036] N91-21103
A modal aeroelastic analysis scheme for turbomachinery blading
[NASA-CR-187089] N91-21138
Dynamic response of a hammerhead launch vehicle wind-tunnel model
[NASA-TM-104050] N91-21177
Model correlation and damage location for large space truss structures: Secant method development and evaluation
[NASA-CR-188102] N91-21213
Fast quasi-explicit finite difference simulation of electrochemical responses initiated by a discontinuous perturbation
[DE91-006917] N91-21271
Frequency response of a supported thermocouple wire: Effects of axial conduction
[NASA-CR-188101] N91-21489
Dynamics of rotating flexible structures by a method of quadratic modes
[DE91-009224] N91-21565
Comparison of several system identification methods for flexible structures
[NASA-TM-104046] N91-21574
Dynamic tube/support interaction in heat exchanger tubes
[DE91-006089] N91-21582
PALM2D: A nonlinear finite element program for the coupled thermomechanical response of solids in two dimensions
[DE91-008423] N91-21584
Implementation of a partitioned algorithm for simulation of large CSI problems
[CU-CSSC-91-4] N91-21730
DYNAMIC STABILITY
Bifurcation analysis of the longitudinal dynamics of a simple powered lifting hypersonic vehicle
[AD-A230826] N91-21118
Stability considerations for magnetic suspension systems using electromagnets mounted in a planar array N91-21202
Research in nonlinear water waves
[AD-A231205] N91-21477
Stochastic and deterministic fluctuations in stimulated Brillouin scattering
[AD-A230988] N91-21522
Research in optical sciences
[AD-A230964] N91-21875
DYNAMIC STRUCTURAL ANALYSIS
Dynamics of rotating flexible structures by a method of quadratic modes
[DE91-009224] N91-21565
Passive dynamic controllers for nonlinear mechanical systems
[NASA-TM-104047] N91-21573
Comparison of several system identification methods for flexible structures
[NASA-TM-104046] N91-21574
Ground-based testing of the dynamics of flexible space structures using band mechanisms
[NASA-CR-188154] N91-21576
Analysis, preliminary design and simulation systems for control-structure interaction problems
[NASA-CR-188018] N91-21729
Implementation of a partitioned algorithm for simulation of large CSI problems
[CU-CSSC-91-4] N91-21730
Second-order discrete Kalman filtering equations for control-structure interaction simulations
[CU-CSSC-91-5] N91-21731
Parallel computations and control of adaptive structures N91-21732
DYNAMIC TESTS
Hydrocarbon-fuel/combustion-chamber-liner materials compatibility
[NASA-CR-187104] N91-21307
DYNAMICAL SYSTEMS
A time delay controller for magnetic bearings N91-21205
Predicting chaos for infinite dimensional dynamical systems: The Kuramoto-Sivashinsky equation, a case study
[NASA-CR-187531] N91-21454
DYNAMO THEORY
Report of the panel on earth structure and dynamics, section 6 N91-21595

E

E REGION
Variability of the Sq focus position in the South American continent
[INPE-4740-PRE/1415] N91-21652
EARTH (PLANET)
Report of the panel on plate motion and deformation, section 2 N91-21591
Report of the panel on earth structure and dynamics, section 6 N91-21595
Report of the panel on earth rotation and reference frames, section 7 N91-21596
EARTH ATMOSPHERE
Parametric entry corridors for lunar/Mars aerocapture missions
[NASA-TM-102178] N91-21168
Estimates of thermochemical relaxation lengths behind normal shock waves relevant to manned lunar and Mars return missions, the aeroassist flight experiment, and Mars entry
[NASA-TM-102879] N91-21471
Multi-core events in cosmic-ray induced interactions with lead at around 10 TeV
[DE91-616827] N91-22062
EARTH CRUST
Report of the panel on earth rotation and reference frames, section 7 N91-21596
EARTH IONOSPHERE
Using the USU ionospheric model to predict radio propagation through a simulated ionosphere
[AD-A231599] N91-21423
EARTH MANTLE
Report of the panel on earth rotation and reference frames, section 7 N91-21596
EARTH OBSERVING SYSTEM (EOS)
Mission to Planet Earth N91-21980
EARTH ORBITAL ENVIRONMENTS
Atomic oxygen degradation of Intelsat 4-type solar array interconnects: Laboratory investigations
[NASA-TM-102175] N91-21286
EARTH ORBITS
Real time assisted tracking for low Earth orbit satellites
[INPE-5157-PRE/1636] N91-21170
Orbital debris sweeper and method
[NASA-CASE-MSC-21534-1] N91-21222
AEOSS design guide for system analysis on Advanced Earth-Orbital Spacecraft Systems
[NASA-TM-100772] N91-21223
AEOSS runtime manual for system analysis on Advanced Earth-Orbital Spacecraft Systems
[NASA-TM-100773] N91-21224
EARTH RESOURCES
Bibliography on the international network of biosphere reserves
[PB90-215518] N91-21600
EARTH ROTATION
Solid earth science in the 1990s. Volume 2: Panel reports
[NASA-TM-4256-VOL-2] N91-21590
Report of the panel on earth rotation and reference frames, section 7 N91-21596
EARTH SURFACE
Report of the panel on the land surface: Process of change, section 5 N91-21594
Estimations of ABL fluxes and other turbulence parameters from Doppler lidar data
[NASA-CR-188053] N91-21665
EARTHQUAKES
Report of the panel on earth rotation and reference frames, section 7 N91-21596
ECOLOGY
ELF communications system, ecological monitoring program: Summary of 1989 progress
[AD-A231497] N91-21419
ECONOMIC ANALYSIS
An economic analysis of counterfeit threaded fasteners in the construction industry
[AD-A231492] N91-21551
The indirect economic effects of the European Space Agency programs
[ESA-BR-63] N91-21975
An introduction to financial and economic analysis: Power projects in industrializing and non-industrialized countries
[DE91-752995] N91-21976
ECONOMIC DEVELOPMENT
Environment fact finding mission report
[PB91-130369] N91-21628
ECONOMIC IMPACT
High performance computing for large eddy simulations: Today and tomorrow
[AD-A231220] N91-21758
ECONOMICS
Environment fact finding mission report
[PB91-130369] N91-21628
ECOSYSTEMS
ELF communications system, ecological monitoring program: Summary of 1989 progress
[AD-A231497] N91-21419
Climate variability and ecosystem response: Proceedings of a Long-Term Ecological Research Workshop
[PB91-119180] N91-21632
Mission to Planet Earth N91-21980
EDDY CURRENTS
Magnetic bearings with zero bias N91-21194
Multiple sensor multifrequency eddy current monitor for solidification and growth N91-21362
Characteristic eddy decomposition of turbulence in a channel
[NASA-TM-100065] N91-21470
High performance computing for large eddy simulations: Today and tomorrow
[AD-A231220] N91-21758
EDDY VISCOSITY
Transonic cascade flow calculations using non-periodic C-type grids N91-21071
EDGE LOADING
Delamination and free edge stresses in laminated plates subjected to constant uniaxial strain (computer program)
[ESDU-90021] N91-21253
EDITING ROUTINES (COMPUTERS)
Instructional Support System (ISS). Beginner's manual (Zenith 248 version only)
[PB91-127332] N91-21734

EDUCATION
A guide to ground vehicle operations on the airport
[AD-A231077] N91-21158
Improving risk communication through interactive training in communication skills
[DE91-008366] N91-21402
SEPEC conference proceedings: Hypermedia and Infromation Reconstruction. Aerospace applications and research directions
[NASA-CR-187935] N91-21940
Computer-assisted knowledge acquisition for hypermedia systems N91-21944
A model for addressing navigation limitations and metacognitive constraints in hypermedia training systems N91-21945
Hypermedia and intelligent tutoring applications in a mission operations environment N91-21948
Integrating knowledge and control into hypermedia-based training environments: Experiments with HyperCLIPS N91-21949
From knowledge presentation to knowledge representation to knowledge construction: Future directions for hypermedia N91-21954
EIGENVALUES
A linear quadratic regulator weight selection algorithm for robust pole assignment
[AD-A230598] N91-21737
ELASTIC BODIES
Deterministic and stochastic sensitivity in computational structural mechanics
[ISSN-0208-5658] N91-21571
ELASTIC DEFORMATION
The overall response of composite materials undergoing large elastic deformations
[AD-A231637] N91-21260
Stability analysis of a fuselage side
[FFA-TN-1990-32] N91-21568
ELASTIC PROPERTIES
Stress-strain gage measurements on a Nevada Test Site (NTS) event using pairs of triple foil gages
[DE91-005061] N91-21497
Elastic response of zone axis (001)-oriented PWA 1480 single crystal: The influence of secondary orientation
[NASA-TM-103782] N91-21558
ELASTIC SCATTERING
Electron distortion effects in quasi-elastic electron scattering
[DE91-009034] N91-21843
ELASTIC SHELLS
Scattering in the time domain from submerged elastic shells at coincidence frequencies
[AD-A231122] N91-21837
ELASTOMERS
Elastomer compatibility with liquid propellant at elevated temperature
[AD-A230973] N91-21327
ELECTRIC ARCS
Broad-beam, high current, metal ion implantation facility
[DE91-009329] N91-21291
Kapton wire arc track testing: Per test procedure KWATT BB01
[NASA-CR-185642] N91-21427
ELECTRIC DIPOLES
Ab initio study of the electric dipole transition moment for the electronic X to C transition in acetylene: Theoretical predictions of the absorption and magnetic circular dichroism intensities
[AD-A231227] N91-21442
ELECTRIC DISCHARGES
Study of asymmetrical electric discharges using particle simulation
[INPE-5198-TDL/427] N91-21432
ELECTRIC FIELDS
A new, simple electrostatic-acoustic hybrid levitator N91-21369
A computer model of the electrostatic positioning system N91-21371
Test report for photonic sensors used in electric field measurement of simulated electromagnetic pulses
[AD-A231597] N91-21422
The physiological effects of 50/60 Hz electromagnetic fields: Standards and guidelines
[DE91-752996] N91-21705
Role of the edge electric field and microturbulence in the L-H transition
[DE91-008925] N91-21888
Effect of electric field inhomogeneities on drift wave instabilities and anomalous transport
[NIFS-72] N91-21893
Enhanced single layer multi-color or luminescent display with coactivators
[NASA-CASE-LAR-14181-1] N91-21911
Data analysis for the Pioneer-Venus electric field detector
[NASA-CR-188099] N91-22056
ELECTRIC IGNITION
Spark-ignited diesel engine
[AD-A230243] N91-21533
ELECTRIC POTENTIAL
Free electron lasers
[AD-A230817] N91-21519
Single element magnetic suspension actuator
[NASA-CASE-LAR-13981-1] N91-21539
ELECTRIC PULSES
An evaluation of GTAW-P versus GTA welding of alloy 718
[NASA-TM-103529] N91-21287
ELECTRIC WIRE
Kapton wire arc track testing: Per test procedure KWATT BB01
[NASA-CR-185642] N91-21427
Survey on electron beam processing technologies
[DE91-759126] N91-21866
ELECTRICAL INSULATION
Kapton wire arc track testing: Per test procedure KWATT BB01
[NASA-CR-185642] N91-21427
ELECTRICAL PROPERTIES
High temperature deformation of silicon
[DE91-009102] N91-21305
Volcanic aerosols: Chemistry, evolution, and effects N91-21645
Theory of the electronic and optical properties of semiconductor heterostructures
[AD-A231438] N91-21929
ELECTRICAL RESISTIVITY
Levelling of microprofiles in electrodeposition
[DE91-009083] N91-21297
Numerical recovery of certain discontinuous electrical conductivities
[NASA-CR-187543] N91-21800
ELECTRICITY
Survey on electron beam processing technologies
[DE91-759126] N91-21866
An introduction to financial and economic analysis: Power projects in industrializing and non-industrialized countries
[DE91-752995] N91-21976
ELECTRO-OPTICS
Observation of the photorefractive effect in a polymer
[AD-A231339] N91-21322
Electro optical system to measure strains at high temperature
[NASA-CR-188148] N91-21492
ELECTROCHEMICAL CORROSION
The use of a scanning electrochemicl impedance spectroscopy technique to investigate localized corrosion
[DE91-006918] N91-21296
ELECTROCHEMISTRY
Fast quasi-explicit finite difference simulation of electrochemical responses initiated by a discontinuous perturbation
[DE91-006917] N91-21271
The use of a scanning electrochemicl impedance spectroscopy technique to investigate localized corrosion
[DE91-006918] N91-21296
Environmentally-induced passivity of aluminum alloys and aluminum metal matrix composites
[AD-A231350] N91-21301
ELECTRODEPOSITION
Levelling of microprofiles in electrodeposition
[DE91-009083] N91-21297
ELECTRODES
Electron transfer between glucose oxidase and electrodes via redox mediators bound with flexible chains to the enzyme surface
[AD-A231115] N91-21856
ELECTRODYNAMICS
Physics without physical constants
[DE91-619576] N91-21935
ELECTROLUMINESCENCE
Enhanced single layer multi-color or luminescent display with coactivators
[NASA-CASE-LAR-14181-1] N91-21911
ELECTROMAGNETIC ABSORPTION
Ab initio study of the electric dipole transition moment for the electronic X to C transition in acetylene: Theoretical predictions of the absorption and magnetic circular dichroism intensities
[AD-A231227] N91-21442
Laboratory evaluation and application of microwave absorption properties under simulated conditions for planetary atmospheres
[NASA-CR-188096] N91-22057
ELECTROMAGNETIC ACCELERATION
Considerations and studies for the construction of acceleration coils for inductive launchers
[ISL-CO-240/89] N91-21173
Advantage of nonguided hypervelocity projectiles in antimissile warfare
[ISL-R-110/90] N91-21174
ELECTROMAGNETIC FIELDS
Thermophysical property measurements in electromagnetic levitators N91-21344
TEMPUS: A facility for containerless electromagnetic processing onboard spacelab N91-21349
TEMPUS: First results N91-21350
ELF communications system, ecological monitoring program: Summary of 1989 progress
[AD-A231497] N91-21419
The physiological effects of 50/60 Hz electromagnetic fields: Standards and guidelines
[DE91-752996] N91-21705
ELECTROMAGNETIC INTERACTIONS
Theory of photon and electron induced reactions
[DE91-008993] N91-21842
ELECTROMAGNETIC INTERFERENCE
Extended database of microwave common carrier antenna gain patterns
[PB91-119206] N91-21398
ELECTROMAGNETIC PULSES
The fast Hartley transform
[AD-A230370] N91-21400
Test report for photonic sensors used in electric field measurement of simulated electromagnetic pulses
[AD-A231597] N91-21422
ELECTROMAGNETIC RADIATION
Resistance seam welding thin copper foils
[DE91-008988] N91-21535
ELECTROMAGNETISM
Containerless processing in the European microgravity programme N91-21337
Feedback controlled electrostatic and electromagnetic sample positioners N91-21370
ELECTROMAGNETS
Five degree-of-freedom control of an ultra-precision magnetically-suspended linear bearing N91-21196
A solid-state controllable power supply for a magnetic suspension wind tunnel N91-21199
Description of the Large-Gap Magnetic Suspension System (LGMSS) ground based experiment N91-21200
Stability considerations for magnetic suspension systems using electromagnets mounted in a planar array N91-21202
ELECTRON ACCELERATION
An unusual case of meter wave type-3 bursts leading millimeter-wave bursts
[INPE-5140-PRE/1628] N91-22064
ELECTRON ACCELERATORS
Grid pulse generator
[DIGEL-1990-6] N91-21863
ELECTRON BEAMS
Transverse klystron
[AD-A231586] N91-21444
High brightness electron beam production by laser induced various order multiphoton photoeffects of gold
[DE91-009150] N91-21514
Advanced, time-resolved imaging techniques for electron-beam characterizations
[DE91-008587] N91-21885
Survey on electron beam processing technologies
[DE91-759126] N91-21866
EBIC (Electron Beam Induced Current) contrast of clean, decorated and deuterium passivated Si(Ge) epitaxial misfit dislocations
[DE91-006967] N91-21912
ELECTRON BUNCHING
Transverse klystron
[AD-A231586] N91-21444
ELECTRON DENSITY (CONCENTRATION)
Modeling the absorption of intense, short laser pulses in steep density gradients
[DE91-008735] N91-21503
ELECTRON DIFFRACTION
In-situ diffraction and imaging studies of heteroepitaxial growth of semi-conductors
[AD-A231568] N91-21932
ELECTRON EMISSION
Plasma contactor research, 1990
[NASA-CR-187097] N91-21880
ELECTRON ENERGY
On the temperature corrections for QED operators in the superstrong magnetic field
[DE91-619627] N91-21822
Plasma contactor research, 1990
[NASA-CR-187097] N91-21880
Characterization of the plasma-switch interaction in the LBL HIF ion source
[DE91-009479] N91-21902
ELECTRON GAS
On the temperature corrections for QED operators in the superstrong magnetic field
[DE91-619627] N91-21822

ELECTRON MICROSCOPY
In-situ diffraction and imaging studies of heteroepitaxial growth of semi-conductors
[AD-A231568] N91-21932
ELECTRON PLASMA
Experimental study project of plasma waves and turbulences
[INPE-5127-RPE/632] N91-21896
ELECTRON PROBES
Dependence of the photorefractive properties of KTa(1-x)Nb(x)O3:Cu,V on Cu valence state concentration
[AD-A230954] N91-21917
ELECTRON SOURCES
Quasilinear simulation of auroral kilometric radiation by a relativistic Fokker-Planck code
[DE91-009736] N91-21656
ELECTRON TRANSFER
Electron transfer between glucose oxidase and electrodes via redox mediators bound with flexible chains to the enzyme surface
[AD-A231115] N91-21856
ELECTRON TRANSITIONS
Double 4f-collapse in Ce(0.9-x)Yb(x)Th(0.1)
[DE91-619752] N91-21908
ELECTRON TUNNELING
Study of relativistic electrons at channeling in a beryllium thick crystals
[DE91-619859] N91-21909
Requirements for SIS receivers in the 500-1000 GHz region N91-22015
ELECTRONIC EQUIPMENT
How clean is clean. How clean is needed
[DE91-008173] N91-21391
Resistance seam welding thin copper foils
[DE91-008988] N91-21535
The necessity for a DOD capability in superconducting electronics
[AD-A231553] N91-21931
ELECTRONIC MODULES
Silicon hybrid Wafer Scale Integration (WSI) used to fabricate a Hilbert transform integrated circuit module
[AD-A230605] N91-21428
ELECTRONS
Studies of synchrotron radiation emission from the NRL modified betatron accelerator
[AD-A231346] N91-21868
ELECTROPHORESIS
High-performance capillary electrophoresis of histones
[DE91-008585] N91-21275
ELECTROSTATIC WAVES
Effect of electric field inhomogeneities on drift wave instabilities and anomalous transport
[NIFS-72] N91-21893
Stabilities of regular motion in the relativistic standard map
[NIFS-73] N91-21894
Experimental study project of plasma waves and turbulences
[INPE-5127-RPE/632] N91-21896
ELECTROSTATICS
Containerless processing in the European microgravity programme N91-21337
The Japanese containerless experiments N91-21338
Containerless protein crystal growth technology: Electrostatic multidrop positioner N91-21352
Feedback controlled electrostatic and electromagnetic sample positioners N91-21370
A computer model of the electrostatic positioning system N91-21371
ELEMENTARY EXCITATIONS
Contributions of conformational and structural defects to the hyper-polarizabilities of polymers
[DE91-009042] N91-21313
ELEMENTARY PARTICLES
Contributions of conformational and structural defects to the hyper-polarizabilities of polymers
[DE91-009042] N91-21313
ELLIPSOMETRY
Ex-situ and in-situ ellipsometric studies of the thermal oxide on InP
[AD-A231095] N91-21283
New materials and new techniques for imaging of long wavelength IR radiation
[AD-A231086] N91-21877
ELLIPTICAL GALAXIES
NGC3309: An S-shaped radio galaxy in a nearby cluster
[INPE-5143-PRE/1631] N91-22054
ELLIPTICITY
A simple model vortex flow past a slender elliptic cone at incidence
[RAE-TM-AERO-2197] N91-21460
EMBEDDED COMPUTER SYSTEMS
Embedded computers: Navy's approach to developing patrol aircraft avionics system too risky
[AD-A230868] N91-21136
EMISSION
Seminar on anthropogenic emissions of greenhouse gases
[DE91-009110] N91-21634
EMISSION SPECTRA
Photochemistry and charge transfer chemistry of the platinum group elements
[DE91-009153] N91-21277
Analysis and interpretation of diffuse x-ray emission using data from the Einstein satellite
[NASA-CR-187988] N91-21728
The 1.3 mm continuum emission from circumstellar envelopes N91-22007
LDR: A submillimeter great observatory N91-22018
First detection of C3H2 at sub-mm wavelengths N91-22022
Excitation of submillimeter water masers N91-22024
Submillimeter observations of interstellar dust N91-22028
The 0 deg (63 micron) line emission from galactic high latitude cirrus clouds N91-22029
EMITTANCE
Study of the absorption lines widened by the effect of pressure, emitted by the combustion gases of propulsive powders
[ISL-R-124/89] N91-21237
Optical property measurements as a diagnostic tool for control of materials processing in space and on Earth N91-21366
EMITTERS
Radar signal categorization using a neural network N91-21782
EMULSIONS
Fundamental investigation of micelles and microemulsions in supercritical fluids
[AD-A231073] N91-21476
ENCAPSULATING
An evaluation of the effects of varying composition and processing on several encapsulating resins
[DE91-009101] N91-21314
END EFFECTORS
Method and apparatus for positioning a robotic end effector
[NASA-CASE-MSC-21476-1] N91-21542
Method and apparatus for configuration control of redundant robots
[NASA-CASE-NPO-17801-1-CU] N91-21544
ENERGY ABSORPTION
Comparison of the post-buckling behavior of metallic and composite plates with centrally located cu touts
[PB91-118844] N91-21563
ENERGY CONVERSION
Fast quasi-explicit finite difference simulation of electrochemical responses initiated by a discontinuous perturbation
[DE91-006917] N91-21271
ENERGY CONVERSION EFFICIENCY
Optimal design study of high efficiency indium phosphide space solar cells
[NASA-TM-103763] N91-21433
ENERGY DISSIPATION
Magnetic bearings with zero bias N91-21194
ICRF heating in reactor grade plasmas
[DE91-005491] N91-21886
ENERGY DISTRIBUTION
Plasma contactor research, 1990
[NASA-CR-187097] N91-21880
ENERGY LEVELS
Electron distortion effects in quasi-elastic electron scattering
[DE91-009034] N91-21843
ENERGY SPECTRA
Cosmic Ray Nuclei (CRN) detector investigation
[NASA-CR-184137] N91-22063
ENERGY STORAGE
Proof of the feasibility of coherent and incoherent schemes for pumping a gamma ray laser
[AD-A230897] N91-21520
Theoretical investigation leading to energy storage in atomic and molecular systems
[AD-A231275] N91-21858
ENERGY TECHNOLOGY
Power technologies and the space future
[NASA-TM-103649] N91-21240
Process integration: Process change and batch processes
[ESDU-90033] N91-21390
FWP executive summaries: Basic energy sciences, materials sciences programs
[DE91-009223] N91-21826
ENERGY TRANSFER
Thermophysical property measurements in electromagnetic levitators N91-21344
ENGINE CONTROL
Integrated flight/propulsion control system design based on a decentralized, hierarchical approach
[NASA-TM-103678] N91-21137
A preliminary evaluation of an F100 engine parameter estimation process using flight data
[NASA-TM-4216] N91-21446
ENGINE DESIGN
Large liquid rocket engine transient performance simulation system
[NASA-CR-184099] N91-21232
Present and future of CFD on the aero-engine development in IHI N91-21381
ENGINE INLETS
A pressure flux-split technique for computation of inlet flow behavior N91-21068
Zonal analysis of two high-speed inlets N91-21089
ENGINE PARTS
Advanced expander test bed program
[NASA-CR-187082] N91-21234
ENGINE TESTS
Nonintrusive nitric oxide density measurements in the NASA Langley arc-heated scramjet engine test facility
[AD-A231260] N91-21142
Advanced expander test bed program
[NASA-CR-187082] N91-21234
Heavy hydrocarbon main injector technology program
[NASA-CR-188082] N91-21235
Boundary layer study. Phase 4: Experimental validation test plan
[AD-A231342] N91-21481
ENVIRONMENT EFFECTS
Kauai Test Facility two experiment rocket campaign
[DE91-008894] N91-21172
Characterization of antropic action in the Mearim (MA) middle-low valley through LANDSAT/TM imagery
[INPE-5075-PRE/1594] N91-21620
Using climate model output to assess the impacts of climate change on water resources
[DE91-004542] N91-21637
Third Information Transfer Meeting
[PB91-123922] N91-21961
ENVIRONMENT MODELS
The micrometeoroid impact hazard in space: Techniques for damage simulation by pulsed lasers and environmental modelling N91-21220
Adaptation of the Advanced Statistical Trajectory Regional Air Pollution (ASTRAP) model to the EPA VAX computer: Modifications and testing
[PB91-127720] N91-21631
ENVIRONMENT POLLUTION
Environment fact finding mission report
[PB91-130369] N91-21628
ENVIRONMENT SIMULATION
Hydrocarbon-fuel/combustion-chamber-liner materials compatibility
[NASA-CR-187104] N91-21307
ENVIRONMENTAL LABORATORIES
Environmental Research Laboratories publication abstracts, fiscal year 1990
[PB91-132035] N91-21627
ENVIRONMENTAL MONITORING
ELF communications system, ecological monitoring program: Summary of 1989 progress
[AD-A231497] N91-21419
Bibliography on the international network of biosphere reserves
[PB90-215518] N91-21600
Experiences in assessing changes in the use of savanna ecosystems
[INPE-5187-PRE/1655] N91-21605
Environmental Research Laboratories publication abstracts, fiscal year 1990
[PB91-132035] N91-21627
Field intercomparison of precipitation samplers for assessing wet deposition of organic contaminants
[PB91-125880] N91-21629
Third Information Transfer Meeting
[PB91-123922] N91-21961
ENVIRONMENTAL SURVEYS
Seminar on anthropogenic emissions of greenhouse gases
[DE91-009110] N91-21634
ENVIRONMENTAL TESTS
ONR tropical cyclone motion research initiative: Field experiment summary
[AD-A231152] N91-21679
ENZYMES
Electron transfer between glucose oxidase and electrodes via redox mediators bound with flexible chains to the enzyme surface
[AD-A231115] N91-21856

EPITAXY
Materials for aerospace vehicles friction drag reduction surfaces
[INPE-5188-PRE/1656] N91-21217
Magnetic field induced broadening of the resistive transition in epitaxial films of YBa2Cu3O7 and Y2Ba4Cu8O16
[DE91-009825] N91-21916
Atomic layer epitaxy of silicon, silicon/germanium, and silicon carbide via extraction/exchange processes
[AD-A231348] N91-21927
In-situ diffraction and imaging studies of heteroepitaxial growth of semi-conductors
[AD-A231568] N91-21932
EPOXY COMPOUNDS
UV cured epoxy resin coatings
[DE91-008180] N91-21303
An evaluation of the effects of varying composition and processing on several encapsulating resins
[DE91-009101] N91-21314
Stress-strain gage measurements on a Nevada Test Site (NTS) event using pairs of triple foil gages
[DE91-005061] N91-21497
EPOXY RESINS
UV cured epoxy resin coatings
[DE91-008180] N91-21303
EQUATIONS OF MOTION
Unstructured grid generation using the distance function N91-21065
A multidimensional finite element method for CFD N91-21079
Second-order discrete Kalman filtering equations for control-structure interaction simulations
[CU-CSSC-91-5] N91-21731
Parallel computations and control of adaptive structures N91-21732
Integrable Hamiltonian system in 2N dimensions
[DE91-619585] N91-21798
EQUATIONS OF STATE
Effect of equations of state on transient burning analysis of pyrotechnic materials in a closed system
[DE91-009167] N91-21280
EQUATORIAL REGIONS
The effects of magnetic storm phases on F-layer irregularities from auroral to equatorial latitudes
[AD-A231373] N91-21658
EQUILIBRIUM METHODS
Ground-based testing of the dynamics of flexible space structures using band mechanisms
[NASA-CR-188154] N91-21576
ERROR ANALYSIS
Assessment of the absolute accuracy of long-baseline kinematic GPS positioning of a moving vehicle
[PB91-129379] N91-21125
Analysis of error in TOMS total ozone as a function of orbit and attitude parameters
[NASA-CR-4361] N91-21670
Data assimilation and wind-stress error correction in a forced tropical ocean model N91-21687
Normalized convergence rates for the PSMG method
[AD-A231311] N91-21764
The James Clerk Maxwell telescope N91-22031
ERROR FUNCTIONS
Optimal Hankel-norm approximation and rational function models using impulse response data
[AD-A231317] N91-21839
ERS-1 (ESA SATELLITE)
Design of a processing facility for synthetic aperture radar data at the Tromso ERS-1 ground station N91-21161
ESSENTIALLY NON-OSCILLATORY SCHEMES
On the application of ENO scheme with subcell resolution to conservation laws with stiff source terms N91-21074
Uniform high order spectral methods for one and two dimensional Euler equations
[NASA-CR-187535] N91-21456
ESTIMATES
Estimations of ABL fluxes and other turbulence parameters from Doppler lidar data
[NASA-CR-188053] N91-21665
Iterative procedures for exact maximum likelihood estimation in the first-order Gaussian moving average model
[AD-A230812] N91-21809
ESTIMATING
Frictional and retarding forces on aircraft tyres. Part 5: Estimation of fluid drag forces
[ESDU-90035] N91-21537
Study of relativistic electrons at channeling in a beryllium thick crystals
[DE91-619859] N91-21909
ETALONS
Optical switching and optical logic in a thermally expanding Si etalon
[AD-A230706] N91-21870
ETCHING
Ex-situ and in-situ ellipsometric studies of the thermal oxide on InP
[AD-A231095] N91-21283
Surface cleaning by laser ablation
[DE91-009189] N91-21505
ETHANE
A study of helium. Argon: Ethane gas mixtures used in drift chambers for large acceptance spectrometers in high magnetic fields
[AD-A231209] N91-21284
ETHERS
Synthesis of imide/arylene ether copolymers for adhesives and composite matrices
[NASA-TM-104067] N91-21306
Imide/arylene ether block copolymers
[NASA-TM-104066] N91-21308
High octane ethers from synthesis gas-derived alcohol
[DE91-008367] N91-21325
ETHYL ALCOHOL
Aerobic production of ethanol
[PB91-119172] N91-21324
EULER EQUATIONS OF MOTION
A finite-difference, frequency-domain numerical scheme for the solution of the linearized unsteady Euler equations N91-21067
Some treatments on boundary conditions for quasi one-dimensional Euler equations
[FFA-TN-1990-36] N91-21469
Convergence of the point vortex method for the 3-D Euler equations
[AD-A231285] N91-21479
A multiblock multigrid three-dimensional Euler equation solver
[NASA-TM-103424] N91-21795
A fully Galerkin method for the recovery of stiffness and damping parameters in Euler-Bernoulli beam models
[NASA-CR-187517] N91-21796
EUROPE
Environment fact finding mission report
[PB91-130369] N91-21628
EUROPEAN SPACE PROGRAMS
The indirect economic effects of the European Space Agency programs
[ESA-BR-63] N91-21975
EUTECTICS
Thermodynamic properties and crystallization kinetics at high liquid undercooling N91-21343
EVAPORATION
Spray combustion modeling and evaluation
[DE91-007923] N91-21264
Drop evaporation in a single-axis acoustic levitator N91-21356
EVAPORATION RATE
Drop evaporation in a single-axis acoustic levitator N91-21356
EXCITATION
Measurements of scattering processes in negative ion-atom collisions
[DE91-009514] N91-21849
EXHAUST DIFFUSERS
Evaluation of air injection in a sudden expansion diffuser for real-time afterburning application
[AD-A230850] N91-21141
EXHAUST EMISSION
Compilation of air pollutant emission factor. Volume 1, supplement C: Stationary point and area sources, fourth edition
[PB91-125906] N91-21630
EXHAUST GASES
Use of natural gas and liquefied petroleum gas in heavy-duty engines
[DE91-752990] N91-21546
EXHAUST NOZZLES
An experimental comparison of nonswirling and swirling flow in a circular-to-rectangular transition duct
[NASA-TM-104359] N91-21115
Hot gas ingestion test results of a two-poster vectored thrust concept with flow visualization in the NASA Lewis 9- x 15-foot low speed wind tunnel
[NASA-TM-103258] N91-21116
EXISTENCE THEOREMS
Existence and uniqueness results for problems arising in connection with the incompressible Navier-Stokes equations
[FFA-TN-1989-43] N91-21468
EXOBIOLOGY
Exploring the living universe: A strategy for space life sciences
[NASA-TM-103399] N91-21696
EXPERIMENT DESIGN
TEMPUS: A facility for containerless electromagnetic processing onboard spacelab N91-21349
Design of experiments to quantify communication satellite system performance
[PB91-129635] N91-21395
Proceedings of the Gordon Conference on Photonuclear Reactions
[DE91-621717] N91-21846
EXPERIMENTATION
Science, medicine and animals
[ISBN-0-309-04439-1] N91-21697
Inhalation toxicology. 11: The effect of elevated temperature on carbon monoxide toxicity
[AD-A231185] N91-21708
EXPERT SYSTEMS
Implementation of an oceanographic expert system: Problems, feedback, solutions
[AD-A230886] N91-21689
IDEAL, a dialogic interface in a natural language for expert systems
[INPE-5151-TDL/424] N91-21742
An object oriented design and implementation of the IDEF(sub 0) essential model using Ada and an Ada based expert system
[AD-A230814] N91-21753
Designing a training tool for imaging mental models
[NASA-CR-187891] N91-21776
Proceedings of the Second Joint Technology Workshop on Neural Networks and Fuzzy Logic, volume 1
[NASA-CP-10061-VOL-1] N91-21778
Fuzzy associative memories N91-21779
Using fuzzy logic to integrate neural networks and knowledge-based systems N91-21788
Intelligent array system
[AD-A231107] N91-21792
SEPEC conference proceedings: Hypermedia and Infromation Reconstruction. Aerospace applications and research directions
[NASA-CR-187935] N91-21940
Experiment Document Information System (EDIS) evolution N91-21941
Computer-assisted knowledge acquisition for hypermedia systems N91-21944
Seven ways to make a hypertext project fail N91-21946
Hypermedia and intelligent tutoring applications in a mission operations environment N91-21948
Integrating knowledge and control into hypermedia-based training environments: Experiments with HyperCLIPS N91-21949
GERM as a tool for space station documentation N91-21950
Automating hypertext for decision support N91-21951
Hypermedia as medium N91-21952
Hypermedia = hypercommunication N91-21953
From knowledge presentation to knowledge representation to knowledge construction: Future directions for hypermedia N91-21954
SEPEC conference proceedings: Hypermedia and Information Reconstruction. Aerospace applications and research directions. Addendum
[NASA-CR-187936] N91-21955
A knowledge base browser using hypermedia N91-21956
AiGERM: A logic programming front end for GERM N91-21957
Knowledge base systems in DMA's digital production system
[AD-A230771] N91-21963
EXPLORATION
Third Information Transfer Meeting
[PB91-123922] N91-21961
EXPLORER SATELLITES
A submillimeter mission for the 1990s: SMMM N91-22019
EXPLOSIVES
Study of the absorption lines widened by the effect of pressure, emitted by the combustion gases of propulsive powders
[ISL-R-124/89] N91-21237
EXPOSURE
Inhalation toxicology. 11: The effect of elevated temperature on carbon monoxide toxicity
[AD-A231185] N91-21708
EXTINGUISHING
Fire suppression in human-crew spacecraft
[NASA-TM-104334] N91-21182
EXTRACTION
Fundamental investigation of micelles and microemulsions in supercritical fluids
[AD-A231073] N91-21476
EXTRAGALACTIC RADIO SOURCES
Extragalactic source counts, confusion limits and contributions to the background radiation in the sub-mm N91-21995
The confusion limits to the sensitivity of submillimeter telescopes N91-22001
EXTRAPOLATION
Experiments on neural network architectures for fuzzy logic N91-21787

EXTRATERRESTRIAL ENVIRONMENTS
Norwegian studies of plasma modifications around spacecraft and how these affect the vehicle potential N91-21166
EXTRATERRESTRIAL RADIATION
Radiation health research, 1986 - 1990 [NASA-TM-4270] N91-21704
EXTREME ULTRAVIOLET RADIATION
Time-resolved extreme-ultraviolet spectroscopy of laser-produced plasmas originating at the parylene layer of microballon targets [DE91-009378] N91-21900
EXTREMELY LOW FREQUENCIES
ELF communications system, ecological monitoring program: Summary of 1989 progress [AD-A231497] N91-21419

F

F REGION
The effects of magnetic storm phases on F-layer irregularities from auroral to equatorial latitudes [AD-A231373] N91-21658
F-14 AIRCRAFT
Predicting F-14 Air Combat Maneuvering (ACM) performance using an automated battery of cognitive/psychomotor tests [AD-A228593] N91-21128
F-15 AIRCRAFT
A preliminary evaluation of an F100 engine parameter estimation process using flight data [NASA-TM-4216] N91-21446
FABRICATION
A new fabrication method for precision antenna reflectors for space flight and ground test [NASA-TP-3078] N91-21185
Modified chemical vapor deposition of gradient index lenses [AD-A230989] N91-21281
Silicon hybrid Wafer Scale Integration (WSI) used to fabricate a Hilbert transform integrated circuit module [AD-A230605] N91-21428
High reliability megawatt transformer/rectifier [NASA-CR-187079] N91-21430
FABRY-PEROT INTERFEROMETERS
The (C II) 158 micron line mapping of spiral galaxies N91-21996
The MPE/UCB Far-Infrared imaging Fabry-Perot Interferometer (FIFI) N91-22005
FABRY-PEROT SPECTROMETERS
Large-scale (CII) 158 micron emission of the Galaxy observed by a balloon-borne telescope N91-22004
A submillimeter mission for the 1990s: SMMM N91-22019
FIR and sub-mm direct detection spectrometers for spaceborne astronomy N91-22026
FACTORIZATION
Implicit solution of three-dimensional internal turbulent flows N91-21082
FAILURE
Materials can be stressed out too [AD-A231351] N91-21589
FAILURE ANALYSIS
Delamination and free edge stresses in laminated plates subjected to constant uniaxial strain (computer program) [ESDU-90021] N91-21253
Modeling failure and reliability in new-generation devices [AD-A230998] N91-21439
Analysis of rolling contact spall life in 440 C steel bearing rims [NASA-CR-184101] N91-21526
Comparison of the post-buckling behavior of metallic and composite plates with centrally located cu touts [PB91-116844] N91-21563
Materials can be stressed out too [AD-A231351] N91-21589
FAILURE MODES
Formation of controlled adiabatic shear bands in AISI 4340 high strength steel [AD-A230999] N91-21300
FAIRINGS
Dynamic response of a hammerhead launch vehicle wind-tunnel model [NASA-TM-104050] N91-21177
FALSE ALARMS
Adaptive detection in subspaces [AD-A231023] N91-21876
FAR INFRARED RADIATION
FIRST: Far Infrared and Submillimeter Space Telescope N91-21990
The galactic center at submillimeter and far-infrared wavelengths N91-22002
Late-type stars at far-infrared and sub-millimeter wavelengths N91-22006
Far-infrared heterodyne technology N91-22016
FIR and sub-mm direct detection spectrometers for spaceborne astronomy N91-22026
The TIR project: A balloon telescope for the measurement of CBR anisotropies N91-22041
FARM CROPS
Spectral characteristics of agricultural crops and yield [INPE-5125-RPE/630] N91-21619
FAST FOURIER TRANSFORMATIONS
Implementation of FFT and pulse compression routines on the SPT frequency domain array processor [AD-A231320] N91-21443
FASTENERS
Overcenter collet space station truss fastener [NASA-CASE-MSC-21504-1] N91-21221
A plane-sweep algorithm for exact simulation of a quasi-static mechanical system of compliantly-connected rigid bodies (extended abstract) [AD-A231324] N91-21550
An economic analysis of counterfeit threaded fasteners in the construction industry [AD-A231492] N91-21551
FATIGUE (MATERIALS)
The mechanical property data base from an Air Force/industry cooperative test program on advanced aluminum alloys (8090 extrusion) [AD-A230903] N91-21299
Engineering property limitations of structural ceramics and ceramic composites above 1600 C [DE91-009105] N91-21311
Superplastic creep of eutectic tin-lead solder joints [DE91-009074] N91-21586
Materials can be stressed out too [AD-A231351] N91-21589
FEASIBILITY ANALYSIS
Analysis and testing of a bistatic radar cross section measurement capability for the AFIT anechoic chamber [AD-A230609] N91-21401
An introduction to financial and economic analysis: Power projects in industrializing and non-industrialized countries [DE91-752995] N91-21976
FEDERAL BUDGETS
Space station: NASA's search for design, cost, and schedule stability continues [GAO/NSIAD-91-125] N91-21187
NASA authorizations [S-HRG-101-981] N91-21977
NASA overview N91-21978
NASA space shuttle/space station N91-21979
Mission to Planet Earth N91-21980
Aeronautics and space technology N91-21981
Space science and applications N91-21982
Commercial space programs N91-21983
FEEDBACK
Feedback controlled electrostatic and electromagnetic sample positioners N91-21370
Theory of semiconductor laser feedback instability [DE91-008198] N91-21512
FEEDBACK CIRCUITS
Phase-lock-loop application for fiber optic receiver [NASA-TM-102776] N91-21435
FEEDBACK CONTROL
Integrated flight/propulsion control system design based on a decentralized, hierarchical approach [NASA-TM-103678] N91-21137
Results of the HHC wind tunnel tests, 1986 - 1988 [DLR-FB-90-42] N91-21152
Nonlinear compensation techniques for magnetic suspension systems N91-21204
Passive dynamic controllers for nonlinear mechanical systems [NASA-TM-104047] N91-21573
Spiral vane bioreactor [NASA-CASE-MSC-21361-1] N91-21701
A linear quadratic regulator weight selection algorithm for robust pole assignment [AD-A230598] N91-21737
Permanent magnet flux-biased magnetic actuator with flux feedback [NASA-CASE-LAR-13785-1] N91-21824
FERROMAGNETISM
Critical behavior in magnetic superlattices [AD-A231327] N91-21925
FIBER COMPOSITES
Mechanical behavior of fiber reinforced SiC/RBSN ceramic matrix composites: Theory and experiment [NASA-TM-103688] N91-21243
Modelling of the impact response of fibre-reinforced composites [OUEL-1863/90] N91-21244
Effect of strain rate on the through-thickness elastic properties of woven laminates N91-21245
Fracture toughness of unidirectional fiber reinforced ceramic composites in Mode 2 utilizing laser interferometry [AD-A231027] N91-21258
Transverse cracking in a fiber reinforced ceramic matrix composite [AD-A231029] N91-21259
Thermal buckling and postbuckling of symmetrically laminated composite plates [NASA-CR-188030] N91-21560
Mode 1 interlaminar fracture toughness of carbon/PEEK participation in an international round robin program [FFA-TN-1990-41] N91-21570
FIBER OPTICS
Test report for photonic sensors used in electric field measurement of simulated electromagnetic pulses [AD-A231597] N91-21422
Phase-lock-loop application for fiber optic receiver [NASA-TM-102776] N91-21435
Electro optical system to measure strains at high temperature [NASA-CR-188148] N91-21492
Preliminary field demonstration of a fiber-optic TCE sensor [DE91-008453] N91-21498
Fiber optic sensing system [NASA-CASE-LEW-14795-1] N91-21871
FIBER ORIENTATION
Structural analysis and optimization of a propfan blade by use of the finite element method [ESA-TT-1216] N91-21566
FIBERS
Material properties of silicon carbide fibers with continuously applied sol-gel alumina coatings [AD-A230825] N91-21256
FIELD EFFECT TRANSISTORS
A solid-state controllable power supply for a magnetic suspension wind tunnel N91-21199
Modeling failure and reliability in new-generation devices [AD-A230998] N91-21439
Subthreshold I-V characteristics of AlGaAs/GaAs MODFETs: The role of unintentional acceptors [AD-A230110] N91-21904
FIELD OF VIEW
Holographic lens for wide field-of-view laser communication receiver [AD-A231620] N91-21502
FIELD THEORY (ALGEBRA)
Critical behavior in magnetic superlattices [AD-A231327] N91-21925
FIELD THEORY (PHYSICS)
Quantization of nonlocal theories and gravitation [DE91-619626] N91-21937
FIGHTER AIRCRAFT
Integrated flight/propulsion control system design based on a decentralized, hierarchical approach [NASA-TM-103678] N91-21137
Rotary-balance testing for aircraft dynamics [AGARD-AR-265] N91-21156
FILTERS
Sample holder support for microscopes [NASA-CASE-MFS-28420-1] N91-21545
FILTRATION
Sample holder support for microscopes [NASA-CASE-MFS-28420-1] N91-21545
FINANCE
An introduction to financial and economic analysis: Power projects in industrializing and non-industrialized countries [DE91-752995] N91-21976
FINITE DIFFERENCE THEORY
A finite-difference, frequency-domain numerical scheme for the solution of the linearized unsteady Euler equations N91-21067
On the application of ENO scheme with subcell resolution to conservation laws with stiff source terms N91-21074
Fast quasi-explicit finite difference simulation of electrochemical responses initiated by a discontinuous perturbation [DE91-006917] N91-21271
GEOSIM: A numerical model for geophysical fluid flow simulation [NASA-TM-103528] N91-21450
Finite difference form of the compressible boundary layer equations in generalized curvilinear coordinates [AD-A231386] N91-21483
A comparison of calculational results with experimental data for long rod projectiles [DE91-009006] N91-21536
A discourse on sensitivity analysis for discretely-modeled structures [NASA-TM-104065] N91-21577

Stability analysis of time-dependent transport algorithms
[DE91-009170] N91-21750
FINITE ELEMENT METHOD
A multidimensional finite element method for CFD N91-21079
Finite element methods for integrated aerodynamic heating analysis
[NASA-CR-188079] N91-21101
Solid rocket booster internal flow analysis by highly accurate adaptive computational methods
[NASA-CR-184141] N91-21239
Analysis of failure in woven carbon/epoxy laminates under quasi-static and impact loading N91-21248
Stress wave propagation in hybrid composite materials N91-21249
Application of the finite element method to random rough surface scattering with Neumann boundary conditions
[AD-A231583] N91-21420
Finite element methods of analysis for 3D inviscid compressible flows
[NASA-CR-186271] N91-21463
Elastic response of zone axis (001)-oriented PWA 1480 single crystal: The influence of secondary orientation
[NASA-TM-103782] N91-21558
Structural analysis and optimization of a propfan blade by use of the finite element method
[ESA-TT-1216] N91-21566
Application of the p-version FE method to geometrically non-linear problems in three dimensions
[FFA-TN-1990-33] N91-21569
Deterministic and stochastic sensitivity in computational structural mechanics
[ISSN-0208-5658] N91-21571
A discourse on sensitivity analysis for discretely-modeled structures
[NASA-TM-104065] N91-21577
PALM2D: A nonlinear finite element program for the coupled thermomechanical response of solids in two dimensions
[DE91-008423] N91-21584
STARS: An integrated general-purpose finite element structural, aeroelastic, and aeroservoelastic analysis computer program
[NASA-TM-101709-REV] N91-21587
Superconducting Super Collider silicon tracking subsystem research and development
[DE91-009227] N91-21862
FINITE VOLUME METHOD
A multiblock multigrid three-dimensional Euler equation solver
[NASA-TM-103424] N91-21795
FIRES
Fire suppression in human-crew spacecraft
[NASA-TM-104334] N91-21182
Dynamics of vegetation and soils of oak/saw palmetto scrub after fire: Observations from permanent transects
[NASA-TM-103817] N91-21635
FITTINGS
Improved fits for the vibrational and rotational constants of many states of nitrogen and oxygen
[AD-A229996] N91-21263
FLARES
Combustion tests of black-powder substitutes for the hand-held signal flare
[AD-A231501] N91-21330
FLASKS
Atmospheric methane data for the period 1986-1988 from the NOAA/CMDL global cooperative flask sampling network
[PB91-129122] N91-21626
FLAT PLATES
Experimental study of boundary layer transition on a heated flat plate
[NASA-TM-103779] N91-21061
FLATNESS
Flat tensile specimen design for advanced composites
[NASA-CR-185261] N91-21252
FLAVOR (PARTICLE PHYSICS)
Strange particles production and absorption in nuclei at high energies
[DE91-620399] N91-21845
FLEXIBILITY
Fracture toughness of unidirectional fiber reinforced ceramic composites in Mode 2 utilizing laser interferometry
[AD-A231027] N91-21258
Flexible diaphragm-extreme temperature usage
[NASA-CASE-MSC-20797-2] N91-21494
Dynamics of rotating flexible structures by a method of quadratic modes
[DE91-009224] N91-21565
FLEXIBLE BODIES
Dynamics of rotating flexible structures by a method of quadratic modes
[DE91-009224] N91-21565
Comparison of several system identification methods for flexible structures
[NASA-TM-104046] N91-21574
Ground-based testing of the dynamics of flexible space structures using band mechanisms
[NASA-CR-188154] N91-21576
Active vibration absorber for CSI evolutionary model: Design and experimental results
[NASA-TM-104048] N91-21578
FLEXIBLE SPACECRAFT
The spacecraft control laboratory experiment optical attitude measurement system
[NASA-TM-102624] N91-21186
FLEXIBLE WINGS
Hot-bench simulation of the active flexible wing wind-tunnel model
[NASA-TM-102758] N91-21144
FLIGHT CHARACTERISTICS
Rotary-balance testing for aircraft dynamics
[AGARD-AR-265] N91-21156
FLIGHT CONTROL
Integrated flight/propulsion control system design based on a decentralized, hierarchical approach
[NASA-TM-103678] N91-21137
Integrated flight/propulsion control design for a STOVL aircraft using H-infinity control design techniques
[NASA-TM-104340] N91-21140
Eigenspace design of helicopter flight control systems
[AD-A231588] N91-21153
Human factors in aviation: Terminal control area boundary conflicts
[NASA-CR-177522] N91-21714
Methodology development for the verification and validation of flight critical systems software, phase 1
[AD-A229932] N91-21735
FLIGHT CREWS
Enhancing tolerance to acceleration (+Gz) stress: The Hook maneuver
[AD-A231094] N91-21707
FLIGHT HAZARDS
Impact of icing on Unmanned Aerial Vehicle (UAV) operations
[AD-A231191] N91-21124
FLIGHT INSTRUMENTS
Charge of the containerless experimentation in microgravity N91-21332
FLIGHT PATHS
Flight path reconstruction using extended Kalman filtering techniques
[DLR-FB-90-41] N91-21108
Impact of icing on Unmanned Aerial Vehicle (UAV) operations
[AD-A231191] N91-21124
FLIGHT SIMULATION
Simulation of nap-of-the-Earth flight in helicopters
[NASA-TM-102830] N91-21131
NASA Ames aerospace systems directorate research
[NASA-TM-103844] N91-22066
FLIGHT TEST INSTRUMENTS
Digital signal conditioning for flight test instrumentation
[NASA-TM-101739] N91-21135
FLIGHT TESTS
Analysis of three icing test flights reaching the aircraft-referred icing degree severe
[DLR-FB-90-34] N91-21123
Identification of the aerodynamic model of the DLR research aircraft ATTAS from flight test data
[DLR-FB-90-40] N91-21130
FLIGHT TRAINING
Enhancing tolerance to acceleration (+Gz) stress: The Hook maneuver
[AD-A231094] N91-21707
A conceptual model of the performance of the United States Air Force flight training program
[AD-A230881] N91-21711
FLIR DETECTORS
Kalman filter tracking of a reflective target using forward looking infrared measurements and laser illumination
[AD-A231196] N91-21524
FLOATING POINT ARITHMETIC
High performance computing for large eddy simulations: Today and tomorrow
[AD-A231220] N91-21758
FLOQUET THEOREM
Analysis of periodic orbits about the Martian moons by continuation techniques
[AD-A231026] N91-22058
FLOW CHARACTERISTICS
Numerical solutions of 2-D multi-stage rotor/stator unsteady flow interactions N91-21070
FLOW CHARTS
Specification of the autonomous missile guidance problem for the TA11 processor. Volume 7: Specification mode 29, N + A + T + H
[FFI-90/4005-VOL-7] N91-21147
FLOW DISTRIBUTION
Thoughts on the chimera method of simulation of three-dimensional viscous flow N91-21063
A pressure flux-split technique for computation of inlet flow behavior N91-21068
Simulation of turbomachinery flows N91-21069
Two and three-dimensional shock-shock interactions on the blunt leading edges of the hypersonic inlets N91-21088
Zonal analysis of two high-speed inlets N91-21089
Grid generation strategies for turbomachinery configurations N91-21091
The 3D computation of single-expansion-ramp and scramjet nozzles N91-21092
Computational modelling of dump combustors flowfield N91-21096
Numerical simulation of transverse fuel injection N91-21097
A highly efficient engineering tool for three-dimensional scramjet flowfield and heat transfer computations N91-21098
Infrared thermography for the qualitative aerodynamic study of a slender body
[ISL-R-122/89] N91-21104
Low speed wind tunnel investigation of propeller slipstream aerodynamic effects on different nacelle/wing combinations. Part 2: Propeller slipstream flow field surveys (velocity components, dynamic, total and static pressure distributions) at zero angle of attack and high power
[FFA-TN-1990-24-PT-2] N91-21109
Hot gas ingestion test results of a two-poster vectored thrust concept with flow visualization in the NASA Lewis 9- x 15-foot low speed wind tunnel
[NASA-TM-103258] N91-21116
Investigation of nose bluntness and angle of attack effects on slender bodies in viscous hypertension flows
[NASA-CR-188153] N91-21117
Prediction of unsteady transonic separated flow for missile applications
[AD-A231259] N91-21120
Lift and rolling moment due to spoilers on wings at subsonic speeds
[ESDU-90030] N91-21129
Evaluation of air injection in a sudden expansion diffuser for real-time afterburning application
[AD-A230850] N91-21141
An experimental study of exit flow patterns in a multistage compressor in rotating stall
[AD-A231353] N91-21143
CFD research and systems in Kawasaki Heavy Industries and its future prospects N91-21382
CFD development present and prospects at NAL N91-21385
CFD for hypersonic propulsion
[NASA-TM-103791] N91-21447
Application of computational fluid dynamics in high speed aeropropulsion
[NASA-TM-103780] N91-21458
An experimental investigation of circulation control flow fields using holographic interferometry
[NASA-CR-166482] N91-21459
Transition and turbulence
[ESA-TT-1219] N91-21465
Method and apparatus for detecting laminar flow separation and reattachment
[NASA-CASE-LAR-13952-2-SB] N91-21472
Graduate fellowship in hypersonics
[AD-A231263] N91-21478
A modified SLIC material interface reconstruction algorithm for Eulerian codes
[DE91-009175] N91-21740
FLOW EQUATIONS
Distributed Minimal Residual (DMR) method for acceleration of iterative algorithms N91-21077
Numerical investigation of an internal layer in turbulent flow over a curved hill N91-21083
FLOW GEOMETRY
Zonal analysis of two high-speed inlets N91-21089
An experimental comparison of nonswirling and swirling flow in a circular-to-rectangular transition duct
[NASA-TM-104359] N91-21115
FLOW STABILITY
Computation of supersonic and low subsonic cascade flows using an explicit Navier-Stokes technique and the kappa-epsilon turbulence model N91-21072
Wave models for turbulent free shear flows N91-21086
General three-dimensional disturbances to inviscid Couette flow
[DE91-009593] N91-21474
FLOW THEORY
Large eddy simulation: Where do we stand
[AD-A230835] N91-21657

FLOW VISUALIZATION
Hot gas ingestion test results of a two-poster vectored thrust concept with flow visualization in the NASA Lewis 9- x 15-foot low speed wind tunnel
[NASA-TM-103258] N91-21116
Transition and turbulence
[ESA-TT-1219] N91-21465
Flow visualization ion helicopter blades using Acenaphthen
[DLR-FB-90-37] N91-21466
FLUE GASES
Sampling and characterization of aerosols
[LUNDD/TMAT-90/2002] N91-21269
FLUID DYNAMICS
Containerless experiments in fluid physics in microgravity N91-21341
A new, simple electrostatic-acoustic hybrid levitator N91-21369
FLUID FLOW
A multidimensional finite element method for CFD N91-21079
Solid rocket booster internal flow analysis by highly accurate adaptive computational methods
[NASA-CR-184141] N91-21239
GEOSIM: A numerical model for geophysical fluid flow simulation
[NASA-TM-103528] N91-21450
FLUID JETS
Experimental and theoretical studies of vertical annular liquid jets
[DE91-008042] N91-21461
FLUID MECHANICS
Generation and use of unstructured grids for turbomachinery calculations N91-21064
Center for low-gravity fluid mechanics and transport phenomena
[NASA-CR-188048] N91-21452
The sound of moving bodies
[NASA-TM-103342] N91-21827
Dip coating of sol-gels
[DE91-007571] N91-21872
FLUORINE ORGANIC COMPOUNDS
High octane ethers from synthesis gas-derived alcohol
[DE91-008367] N91-21325
FLUTTER ANALYSIS
Span reduction effects on the flutter characteristics of arrow-wing supersonic transport configurations
[NASA-TP-3077] N91-21127
FLUX VECTOR SPLITTING
Flux-vector splitting for the 1990s N91-21073
A multiblock multigrid three-dimensional Euler equation solver
[NASA-TM-103424] N91-21795
FLYING PLATFORMS
System and method for measuring ocean surface currents at locations remote from land masses using synthetic aperture radar
[NASA-CASE-NPO-17937-1-CU] N91-21621
FOCAL PLANE DEVICES
AEDC focal plane array test capability
[AD-A230846] N91-21408
Laterally stacked Schottky diodes for infrared sensor applications
[NASA-CASE-NPO-17426-1-CU] N91-21434
FOILS (MATERIALS)
Stress-strain gage measurements on a Nevada Test Site (NTS) event using pairs of triple foil gages
[DE91-005061] N91-21497
FOOD PROCESSING
International document on food irradiation
[DE91-615879] N91-21715
FORBIDDEN TRANSITIONS
Theoretical study of the radiative lifetime for the spin-forbidden transition a3 (sigma u +) to X1 (sigma g +) in He2
[AD-A230956] N91-21854
FORCE DISTRIBUTION
Computer program for the calculation of normal force and pitching moment of forebody-cylinder combinations at angles of attack up to 90 degrees and Mach numbers up to 5, including effects of conical boat-tailing
[ESDU-90034] N91-21102
FORCED CONVECTION
Supercritical microgravity droplet vaporization N91-21354
FOREBODIES
Computer program for the calculation of normal force and pitching moment of forebody-cylinder combinations at angles of attack up to 90 degrees and Mach numbers up to 5, including effects of conical boat-tailing
[ESDU-90034] N91-21102
FORECASTING
Objective use of satellite altimetry and IR in simulations of western boundary current dynamics
[AD-A231628] N91-21695
FORESTS
Comparative analysis of AVHRR/NOAA and TM/LANDSAT data in the delimitation of savanna/forest contact area: Preliminary results
[INPE-5200-RPE/639] N91-21611
FORM FACTORS
Electron distortion effects in quasi-elastic electron scattering
[DE91-009034] N91-21843
FORMALDEHYDE
Organic aerogels: A new type of ultrastructured polymer
[DE91-008500] N91-21312
FORTRAN
GRESS: A preprocessor for sensitivity studies on FORTRAN programs
[DE91-009561] N91-21751
The IBM RISC System/6000 and linear algebra operations
[DE91-009221] N91-21805
FOULING
Heat-rate improvements obtained with the use of enhanced tubes in surface condensers
[DE91-006565] N91-21449
FOURIER ANALYSIS
Stability analysis of time-dependent transport algorithms
[DE91-009170] N91-21750
On one-sided filters for spectral Fourier approximations of discontinuous functions
[NASA-CR-187541] N91-21801
FOURIER SERIES
Characteristic eddy decomposition of turbulence in a channel
[NASA-TM-100065] N91-21470
FOURIER TRANSFORMATION
Applications and current limitations of matrix-assisted laser desorption Fourier transform mass spectrometry for biomolecules
[DE91-008877] N91-21265
Serrated circular apertures: Optical Fourier transforms and fractal analysis
[AD-A230834] N91-21874
FRACTALS
Serrated circular apertures: Optical Fourier transforms and fractal analysis
[AD-A230834] N91-21874
The stucture of molecular clouds: New questions N91-22011
FRACTIONATION
High-performance capillary electrophoresis of histones
[DE91-008585] N91-21275
FRACTURE MECHANICS
The mechanical property data base from an Air Force/industry cooperative test program on advanced aluminum alloys (8090 extrusion)
[AD-A230903] N91-21299
Analysis of rolling contact spall life in 440 C steel bearing rims
[NASA-CR-184101] N91-21526
Nondestructive imaging of materials microstructure using x ray tomographic microscopy
[DE91-008505] N91-21554
FRACTURE STRENGTH
Acoustic emission-fracture strength relations for Al/Gr composites
[DE91-009106] N91-21251
Fracture toughness of unidirectional fiber reinforced ceramic composites in Mode 2 utilizing laser interferometry
[AD-A231027] N91-21258
Strength of polymer interfaces
[AD-A230839] N91-21318
Fully articulated four-point-bend loading fixture
[NASA-CASE-LEW-14776-1] N91-21540
Contributions to the analysis of the DCB-specimen
[FFA-TN-1990-22] N91-21567
Mode 1 interlaminar fracture toughness of carbon/PEEK participation in an international round robin program
[FFA-TN-1990-41] N91-21570
FRAGMENTATION
Corrections to the participant-spectator model of high-energy alpha-particle fragmentation
[NASA-TM-4262] N91-21860
FREE CONVECTION
Supercritical microgravity droplet vaporization N91-21354
FREE ELECTRON LASERS
Design overview of a highly stable infrared free electron laser at LBL
[DE91-009327] N91-21508
Free electron lasers
[AD-A230817] N91-21519
Advanced, time-resolved imaging techniques for electron-beam characterizations
[DE91-008587] N91-21865
Transverse flow gas lens
[AD-A231366] N91-21878
FREE FLIGHT
Practical methods to evaluate the friction drag coefficient of a projectile in free flight
[ISL-R-123/89] N91-21105
FREE FLOW
Experimental study of boundary layer transition on a heated flat plate
[NASA-TM-103779] N91-21061
Wave models for turbulent free shear flows N91-21086
FREE JETS
Variational method in the statistical theory of turbulence
[AD-A231621] N91-21484
FREE RADICALS
Specificity of mutation induced by ionizing radiation and oxidizing free radicals
[DE91-008838] N91-21702
FREE VIBRATION
Surface tension and viscosity from damped free oscillations of viscous droplets N91-21346
Rheological properties, shape oscillations, and coalescence of liquid drops with surfactants N91-21357
FREQUENCY CONTROL
Quartz crystal resonators and oscillators for frequency control and timing applications: A tutorial, revision 4
[AD-A231604] N91-21445
Comparison of 14 decibels versus 20 decibels desired to undesired signal protection ratios
[DOT/FAA/CT-TN89/69] N91-21833
FREQUENCY DISTRIBUTION
The microwave background: Its smoothness and frequency distribution as an astrophysical product N91-21992
FREQUENCY HOPPING
Definition of the concept of an interferometric spectrum analyzer for the detection of frequency hopping radios
[AD-A231031] N91-21413
FREQUENCY RANGES
Comparison of 14 decibels versus 20 decibels desired to undesired signal protection ratios
[DOT/FAA/CT-TN89/69] N91-21833
FREQUENCY RESPONSE
Frequency response calibration of recess-mounted pressure transducers
[NASA-TM-104031] N91-21834
FREQUENCY STANDARDS
Quartz crystal resonators and oscillators for frequency control and timing applications: A tutorial, revision 4
[AD-A231604] N91-21445
Comparison of 14 decibels versus 20 decibels desired to undesired signal protection ratios
[DOT/FAA/CT-TN89/69] N91-21833
FREQUENCY SYNCHRONIZATION
Hypercube clock synchronization
[DE91-009222] N91-21774
FRICTION
Micromechanisms of friction in electrogalvanized sheet steel with emphasis on the role of texture
[DE91-009113] N91-21290
FRICTION DRAG
Practical methods to evaluate the friction drag coefficient of a projectile in free flight
[ISL-R-123/89] N91-21105
Materials for aerospace vehicles friction drag reduction surfaces
[INPE-5188-PRE/1656] N91-21217
FRICTION FACTOR
Frictional and retarding forces on aircraft tyres. Part 5: Estimation of fluid drag forces
[ESDU-90035] N91-21537
FUEL COMBUSTION
Preliminary calibration of a generic scramjet combustor
[NASA-CR-187539] N91-21139
Laser probes of natural gas ignition chemistry
[PB91-127993] N91-21262
On the dynamics of the combustion process of hydrogen-air and hydrogen-methane-air mixtures
[ESA-TT-1198] N91-21268
Simulation of chemical kinetics in combustion
[DE91-008446] N91-21273
Elastomer compatibility with liquid propellant at elevated temperature
[AD-A230973] N91-21327
Compilation of air pollutant emission factor. Volume 1, supplement C: Stationary point and area sources, fourth edition
[PB91-125906] N91-21630
FUEL CONSUMPTION
A stochastic approach to the problem of spacecraft optimal manoeuvres
[INPE-5192-PRE/1660] N91-21171

FUEL INJECTION
Numerical simulation of transverse fuel injection N91-21097
Heavy hydrocarbon main injector technology program [NASA-CR-188082] N91-21235
FUEL TANKS
Tank gauging apparatus and method [NASA-CASE-MSC-21059-3] N91-21495
FUELS
Spray combustion modeling and evaluation [DE91-007923] N91-21264
FUNCTIONAL DESIGN SPECIFICATIONS
Integrated flight/propulsion control system design based on a decentralized, hierarchical approach [NASA-TM-103678] N91-21137
Designing a training tool for imaging mental models [NASA-CR-187891] N91-21776
Functional specifications for mathematical computations [DE91-006002] N91-21803
FUNCTIONS (MATHEMATICS)
Interior-point methods for convex programming [AD-A231372] N91-21765
FURNACES
Multiple sensor multifrequency eddy current monitor for solidification and growth N91-21362
FUSELAGES
Stability analysis of a fuselage side [FFA-TN-1990-32] N91-21568
FUZZY SETS
Proceedings of the Second Joint Technology Workshop on Neural Networks and Fuzzy Logic, volume 1 [NASA-CP-10061-VOL-1] N91-21778
Fuzzy associative memories N91-21779
FUZZY SYSTEMS
Proceedings of the Second Joint Technology Workshop on Neural Networks and Fuzzy Logic, volume 1 [NASA-CP-10061-VOL-1] N91-21778
Fuzzy associative memories N91-21779
The simplification of fuzzy control algorithm and hardware implementation N91-21781
Single board system for fuzzy inference N91-21784
Learning control of inverted pendulum system by neural network driven fuzzy reasoning: The learning function of NN-driven fuzzy reasoning under changes of reasoning environment N91-21785
Solution of inverse problem of fuzzy relational equation by using perceptron model N91-21786
Experiments on neural network architectures for fuzzy logic N91-21787
Using fuzzy logic to integrate neural networks and knowledge-based systems N91-21788

G

GALACTIC CLUSTERS
NGC3309: An S-shaped radio galaxy in a nearby cluster [INPE-5143-PRE/1631] N91-22054
GALACTIC COSMIC RAYS
Indirect detection of heavy supersymmetric dark matter [DE91-009669] N91-22055
GALACTIC EVOLUTION
Early COBE results and superconducting cosmic strings N91-21989
Extragalactic source counts, confusion limits and contributions to the background radiation in the sub-mm N91-21995
GALACTIC NUCLEI
The galactic center at submillimeter and far-infrared wavelengths N91-22002
GALACTIC RADIATION
Japanese space programmes of IR and sub-mm astronomy N91-21997
Millimeter observations of a complete sample of galaxies: Implications for gas mass and cold dust component N91-21999
The importance of submillimetre observations of radio quiet and radio loud AGN's N91-22000
LDR: A submillimeter great observatory N91-22018
GALACTIC STRUCTURE
The galactic center at submillimeter and far-infrared wavelengths N91-22002
The University of Tokyo-Norbeyama Radio Observatory submillimeter survey telescope N91-22051
NGC3309: An S-shaped radio galaxy in a nearby cluster [INPE-5143-PRE/1631] N91-22054
GALAXIES
Submillimeter observations of extragalactic objects in the wavelength range 50 microns to 1 mm N91-21994
Millimeter observations of a complete sample of galaxies: Implications for gas mass and cold dust component N91-21999
GALERKIN METHOD
A fully Galerkin method for the recovery of stiffness and damping parameters in Euler-Bernoulli beam models [NASA-CR-187517] N91-21796
GALILEO PROJECT
Post-encapsulation plutonia reduction for Galileo and Ulysses GPHS modules: The Module Reduction and Monitoring Facility (MRMF) [DE91-008131] N91-21861
GALLIUM ARSENIDES
GaAs monolithic RF modules for SARSAT distress beacons [NASA-TM-104338] N91-21184
Ultraviolet photoelectron spectra of gallium arsenide clusters [AD-A224927] N91-21261
Subthreshold I-V characteristics of AlGaAs/GaAs MODFETs: The role of unintentional acceptors [AD-A230110] N91-21904
Molecular beam epitaxial growth and electronic properties of GaP-on-Si (211) heterostructures, and of related systems [AD-A231125] N91-21921
GAME THEORY
An economic analysis of counterfeit threaded fasteners in the construction industry [AD-A231492] N91-21551
GAMMA RAY BURSTS
An unusual case of meter wave type-3 bursts leading millimeter-wave bursts [INPE-5140-PRE/1628] N91-22064
GAMMA RAY LASERS
Proof of the feasibility of coherent and incoherent schemes for pumping a gamma ray laser [AD-A230897] N91-21520
GAMMA RAYS
Experimental response functions and response matrices for 2.54-cm x 2.54 cm and 7.62 cm x 7.62 cm bismuth germanate scintillation detectors [AD-A230140] N91-21486
Specificity of mutation induced by ionizing radiation and oxidizing free radicals [DE91-008838] N91-21702
Colorado School of Mines fusion gamma ray diagnostic project [DE91-009259] N91-21889
GAS ANALYSIS
Sampling and characterization of aerosols [LUNDD/TMAT-90/2002] N91-21269
GAS COMPOSITION
Volcanic aerosols: Chemistry, evolution, and effects N91-21645
GAS DYNAMICS
Distributed Minimal Residual (DMR) method for acceleration of iterative algorithms N91-21077
Uniform high order spectral methods for one and two dimensional Euler equations [NASA-CR-187535] N91-21456
GAS FLOW
Thermophysical property measurements in electromagnetic levitators N91-21344
Tank gauging apparatus and method [NASA-CASE-MSC-21059-3] N91-21495
Construction of flowing afterglow apparatus [AD-A231062] N91-21855
Transverse flow gas lens [AD-A231366] N91-21878
GAS GIANT PLANETS
Laboratory evaluation and application of microwave absorption properties under simulated conditions for planetary atmospheres [NASA-CR-188096] N91-22057
GAS INJECTION
Numerical simulation of transverse fuel injection N91-21097
GAS LASERS
A discussion of the xenon laser intensity as a function of pump rate [DE91-009225] N91-21506
Optical properties of a nuclear reactor pumped gas laser [DE91-009226] N91-21507
Amplification of femtosecond pulses using a N2 pump laser [DE91-008413] N91-21513
GAS MIXTURES
A study of helium. Argon: Ethane gas mixtures used in drift chambers for large acceptance spectrometers in high magnetic fields [AD-A231209] N91-21284
GAS TUNGSTEN ARC WELDING
An evaluation of GTAW-P versus GTA welding of alloy 718 [NASA-TM-103529] N91-21287
GAS-GAS INTERACTIONS
Interaction of surface waves and near surface currents [AD-A231612] N91-21694
GAS-SOLID INTERACTIONS
Materials for aerospace vehicles friction drag reduction surfaces [INPE-5188-PRE/1656] N91-21217
GASIFICATION
Scanning tunneling microscopy of reactive sites: Gasification of graphite by oxygen and hydrogen [DE91-008569] N91-21274
GASKETS
O-ring gasket test fixture [NASA-CASE-MFS-28376-1] N91-21175
GEOCHEMISTRY
A digital data bank for geological exploration in the mining belt of the Pojuca (Carajas) Cu-Zn deposit, based on geological, geochemical, remote sensing, and elevation data [INPE-5172-PRE/1641] N91-21617
GEODESY
Bifurcation analysis of the longitudinal dynamics of a simple powered lifting hypersonic vehicle [AD-A230826] N91-21118
GEODETIC SURVEYS
Report of the panel on earth structure and dynamics, section 6 N91-21595
GEODYNAMICS
Solid earth science in the 1990s. Volume 2: Panel reports [NASA-TM-4256-VOL-2] N91-21590
Report of the panel on earth structure and dynamics, section 6 N91-21595
Report of the panel on geopotential fields: Magnetic field, section 9 N91-21598
GEOGRAPHIC INFORMATION SYSTEMS
Proposed methodology for the study of urban environment and space structure in metropolitan area [INPE-5203-PRE/1665] N91-21216
Registration of windfall damage in the eastern Hunsrueck Plateau (Fed. Republic of Germany) utilizing LANDSAT TM data: A landscape-ecological analysis for practical forestry [DLR-FB-90-31] N91-21601
Design and development of the terrain information extraction system [AD-A231166] N91-21623
Scan-line methods in spatial data systems [AD-A231165] N91-21973
Geographic information systems: A primer [AD-A231465] N91-21974
GEOGRAPHY
The hemispheric eighth mesh terrain elevation and geography data sets [AD-A231592] N91-21624
GEOLOGICAL SURVEYS
Report of the panel on lithospheric structure and evolution, section 3 N91-21592
Spot 1: Imagery in geologic mapping: A comparative study with several remote sensing products in the Curaca River Valley, Bahia [INPE-5136-PRE/1624] N91-21608
GEOLOGY
Volcanism-Climate Interactions [NASA-CP-10062] N91-21641
Physical property measurements on analog granites related to the joint verification experiment [AD-A230571] N91-21650
Audiomagnetotelluric (AMT) soundings in the proximity of the Camaqua (RS) mines [INPE-5213-RPE/641] N91-21651
GEOMAGNETIC LATITUDE
Variability of the Sq focus position in the South American continent [INPE-4740-PRE/1415] N91-21652
The effects of magnetic storm phases on F-layer irregularities from auroral to equatorial latitudes [AD-A231373] N91-21658
GEOMAGNETISM
Solid earth science in the 1990s. Volume 2: Panel reports [NASA-TM-4256-VOL-2] N91-21590
Report of the panel on earth structure and dynamics, section 6 N91-21595
Report of the panel on geopotential fields: Magnetic field, section 9 N91-21598
Audiomagnetotelluric (AMT) soundings in the proximity of the Camaqua (RS) mines [INPE-5213-RPE/641] N91-21651
Geodynamics branch data base for main magnetic field analysis [NASA-TM-104542] N91-21653

Geomagnetic model investigations for 1980 - 1989: A model for strategic defense initiative particle beam experiments and a study in the effects of data types and observatory bias solutions
[NASA-TM-104541] N91-21654
National Geophysical Data Center: Programs and services (25th anniversary 1965-1990)
[PB91-123356] N91-21960
Solar-geophysical data number 553, September 1990. Part 1: (Prompt reports). Data for August 1990, July 1990, and late data
[PB91-113019] N91-22059

GEOMETRIC ACCURACY
Image quality of the PRONAOS telescope N91-22039

GEOMETRICAL OPTICS
On the response of the special sensor microwave/imager to the marine environment: Implications for atmospheric parameter retrievals
[NASA-CR-188032] N91-21664

GEOMETRY
Interplay between local environment effect and electronic structure properties in close packed structures
[DE91-008506] N91-21915

GEOPHYSICAL SATELLITES
Satellite altimetry for naval oceanography
[AD-A231081] N91-21691

GEOPHYSICS
GEOSIM: A numerical model for geophysical fluid flow simulation
[NASA-TM-103528] N91-21450
Report of the panel on lithospheric structure and evolution, section 3 N91-21592
Report of the panel on geopotential fields: Magnetic field, section 9 N91-21598
Environmental Research Laboratories publication abstracts, fiscal year 1990
[PB91-132035] N91-21627
Large eddy simulation: Where do we stand
[AD-A230835]. N91-21657
National Geophysical Data Center: Programs and services (25th anniversary 1965-1990)
[PB91-123356] N91-21960
Solar-geophysical data number 553, September 1990. Part 1: (Prompt reports). Data for August 1990, July 1990, and late data
[PB91-113019] N91-22059

GEOPOTENTIAL
Solid earth science in the 1990s. Volume 2: Panel reports
[NASA-TM-4256-VOL-2] N91-21590
Report of the panel on geopotential fields: Gravity field, section 8 N91-21597
Report of the panel on geopotential fields: Magnetic field, section 9 N91-21598
Report of the panel on international programs N91-21599

GEOTECHNICAL ENGINEERING
Verification of parameters and morphological-environmental properties, by satellite imagery, for studies of coastal region planning
[INPE-5177-PRE/1646] N91-21606

GERMANIUM
Atomic layer epitaxy of silicon, silicon/germanium, and silicon carbide via extraction/exchange processes
[AD-A231348] N91-21927

GERMANIUM ALLOYS
EBIC (Electron Beam Induced Current) contrast of clean, decorated and deuterium passivated Si(Ge) epitaxial misfit dislocations
[DE91-006967] N91-21912

GLASS
Modified chemical vapor deposition of gradient index lenses
[AD-A230989] N91-21281
Containerless synthesis of interesting glasses N91-21340
Reluctant glass formers and their applications in optical lens design N91-21351

GLOBAL POSITIONING SYSTEM
Assessment of the absolute accuracy of long-baseline kinematic GPS positioning of a moving vehicle
[PB91-129379] N91-21125
System and method for measuring ocean surface currents at locations remote from land masses using synthetic aperture radar
[NASA-CASE-NPO-17937-1-CU] N91-21621

GLOBAL WARMING
Cloud and ocean effects on global greenhouse warming
[DE91-008842] N91-21639

GLOTTIS
Enhancing tolerance to acceleration (+Gz) stress: The Hook maneuver
[AD-A231094] N91-21707

GLOVES
The effects of chemical protective gloves and glove liners on manual dexterity
[AD-A231250] N91-21721

GLUCOSE
Electron transfer between glucose oxidase and electrodes via redox mediators bound with flexible chains to the enzyme surface
[AD-A231115] N91-21856

GLUONS
Review of CERN heavy-ion physics
[DE91-009326] N91-21844

GOES SATELLITES
Satellite cloud analyses: A nowcasting capability for the US Navy's TESS(3)
[AD-A231120] N91-21676

GOGGLES
A compatibility assessment of the protective integrated hood mask with ANVIS night vision goggles
[AD-A229956] N91-21716
A field evaluation of the compatibility of the protective integrated hood mask with ANVIS night vision goggles
[AD-A230237] N91-21718

GOLD
Potentiometric titration of gold, platinum, and some other precious metals
[DE91-008989] N91-21276
High brightness electron beam production by laser induced various order multiphoton photoeffects of gold
[DE91-009150] N91-21514
Nucleation and growth of diamond on Si, Cu and Au substrates
[AD-A231044] N91-21918

GOVERNMENTS
Unified agenda of Federal regulations, October 1990
[PB91-120527] N91-21984

GRAIN BOUNDARIES
Grain boundaries
[DE91-007932] N91-21905

GRANITE
Physical property measurements on analog granites related to the joint verification experiment
[AD-A230571] N91-21650

GRAPHIC ARTS
An object oriented design and implementation of the IDEF(sub 0) essential model using Ada and an Ada based expert system
[AD-A230814] N91-21753
Graphical representation of parallel algorithmic processes
[AD-A231258] N91-21760

GRAPHITE
Acoustic emission-fracture strength relations for Al/Gr composites
[DE91-009106] N91-21251
Scanning tunneling microscopy of reactive sites: Gasification of graphite by oxygen and hydrogen
[DE91-008569] N91-21274
Controlling fundamentals in high-energy high-rate pulsed power materials processing of powdered tungsten, titanium aluminides, and copper-graphite composites
[AD-A230900] N91-21298
Comparison of beryllium and graphite first-walls in JET
[DE91-005489] N91-21884

GRAPHITE-EPOXY COMPOSITES
Impact damage in curved graphite/epoxy panels with clamped edges
[AD-A230853] N91-21257
Large deformation behavior of long shallow cylindrical composite panels
[NASA-CR-4355] N91-21557
Stacking-sequence optimization for buckling of laminated plates by integer programming
[NASA-TM-104033] N91-21580

GRASSLANDS
Experiences in assessing changes in the use of savanna ecosystems
[INPE-5187-PRE/1655] N91-21605
Comparative analysis of AVHRR/NOAA and TM/LANDSAT data in the delimitation of savanna/forest contact area: Preliminary results
[INPE-5200-RPE/639] N91-21611

GRAVITATION
Solid earth science in the 1990s. Volume 2: Panel reports
[NASA-TM-4256-VOL-2] N91-21590
Report of the panel on geopotential fields: Gravity field, section 8 N91-21597
Can non-Gaussian fluctuations for structure formation arise from inflation
[DE91-009458] N91-21655
National Geophysical Data Center: Programs and services (25th anniversary 1965-1990)
[PB91-123356] N91-21960

GRAVITATION THEORY
Quantization of nonlocal theories and gravitation
[DE91-619626] N91-21937

GRAVITATIONAL EFFECTS
Control issues of microgravity vibration isolation N91-21192
The gravitomagnetic interaction and its relationship to other relativistic gravitational effects
[NASA-CR-187736] N91-21649
High G physiological protection training
[AGARD-AG-322] N91-21720
Life sciences on-line: A study in hypermedia application N91-21943

GRAVITATIONAL FIELDS
Report of the panel on lithospheric structure and evolution, section 3 N91-21592
Report of the panel on earth structure and dynamics, section 6 N91-21595
Report of the panel on geopotential fields: Gravity field, section 8 N91-21597

GRAVITATIONAL WAVES
Early COBE results and superconducting cosmic strings N91-21989

GRAVITY WAVES
Singularities in water waves and Rayleigh-Taylor instability
[NASA-CR-187530] N91-21455
Power spectra of internal gravity waves
[AD-A231596] N91-21659

GREEN'S FUNCTIONS
Numerical approximations of the Green's functions for a theoretical model of an aperture fed stacked-patch microstrip antenna
[AD-A230702] N91-21429
On the temperature corrections for QED operators in the superstrong magnetic field
[DE91-619627] N91-21822

GREENHOUSE EFFECT
Seminar on anthropogenic emissions of greenhouse gases
[DE91-009110] N91-21634
Cloud and ocean effects on global greenhouse warming
[DE91-008842] N91-21639
Volcanic effects on climate N91-21646

GRID GENERATION (MATHEMATICS)
Computational Fluid Dynamics Symposium on Aeropropulsion
[NASA-CP-3078] N91-21062
Thoughts on the chimera method of simulation of three-dimensional viscous flow N91-21063
Generation and use of unstructured grids for turbomachinery calculations N91-21064
Unstructured grid generation using the distance function N91-21065
Dynamics of local grid manipulations for internal flow problems N91-21090
Grid generation strategies for turbomachinery configurations N91-21091
Finite element methods for integrated aerodynamic heating analysis
[NASA-CR-188079] N91-21101
MATGRID, a program for generation of C-H and C-O topology grids around wing/body configurations: User's guide
[FFA-TN-1991-03] N91-21110
CFD development present and prospects at NAL N91-21385
Domain decomposition methods in computational fluid dynamics
[NASA-CR-187529] N91-21457
Finite element methods of analysis for 3D inviscid compressible flows
[NASA-CR-186271] N91-21463
Application of mesh generation to complex 3-D configurations
[AGARD-AR-268] N91-21464
A multiblock multigrid three-dimensional Euler equation solver
[NASA-TM-103424] N91-21795

GROUND EFFECT MACHINES
Control of free-flying space robot manipulator systems
[NASA-CR-188026] N91-21527

GROUND STATE
On the temperature corrections for QED operators in the superstrong magnetic field
[DE91-619627] N91-21822

GROUND STATIONS
Design of a processing facility for synthetic aperture radar data at the Tromso ERS-1 ground station N91-21161

GROUND SUPPORT EQUIPMENT
A guide to ground vehicle operations on the airport
[AD-A231077] N91-21158

GROUND TESTS
Ground-based and microgravity containerless positioning technologies and facilities N91-21333
Ground-based testing of the dynamics of flexible space structures using band mechanisms
[NASA-CR-188154] N91-21576
GROUND WATER
Preliminary field demonstration of a fiber-optic TCE sensor
[DE91-008453] N91-21498
GROUND WAVE PROPAGATION
Radio wave propagation modeling, prediction and assessment
[AGARD-AG-326] N91-21404
GROUND WIND
Interaction of surface waves and near surface currents
[AD-A231612] N91-21694
GUIDANCE (MOTION)
Entry vehicle performance analysis and atmospheric guidance algorithm for precision landing on Mars
[AD-A231585] N91-21228
GULF STREAM
Implementation of an oceanographic expert system: Problems, feedback, solutions
[AD-A230886] N91-21689
GUSTS
Gust front/wind shift detection algorithm for the terminal Doppler weather radar
[DOT/FAA/NR-91/4] N91-21671
GYROSCOPES
The gravitomagnetic interaction and its relationship to other relativistic gravitational effects
[NASA-CR-187736] N91-21649

H

HADRONS
Diffusive transport enhancement by isolated resonances and distribution tails growth in hadronic beams
[DE91-006379] N91-21864
HALOGENS
Sources of volcanic aerosols: Petrologic and volcanological constraints N91-21644
HAMILTON-JACOBI EQUATION
Unstructured grid generation using the distance function N91-21065
HAMILTONIAN FUNCTIONS
Deterministic and stochastic sensitivity in computational structural mechanics
[ISSN-0208-5658] N91-21571
Integrable Hamiltonian system in 2N dimensions
[DE91-619585] N91-21798
HARMONIC CONTROL
Results of the HHC wind tunnel tests, 1986 - 1988
[DLR-FB-90-42] N91-21152
HARMONIC FUNCTIONS
Spectral analysis of the heliotron field with the toroidal harmonic function in a study of the structure of built-in divertor
[NIFS-71] N91-21892
HAZARDS
Space vehicle propulsion systems: Environmental space hazards
[NASA-CR-188094] N91-21236
Model rocketry hazard study
[DOT/FAA/CT-TN90/28] N91-21238
HEALTH
Radiation health research, 1986 - 1990
[NASA-TM-4270] N91-21704
HEALTH PHYSICS
Radiation health research, 1986 - 1990
[NASA-TM-4270] N91-21704
HEAO 2
Analysis and interpretation of diffuse x-ray emission using data from the Einstein satellite
[NASA-CR-187988] N91-21728
HEAT AFFECTED ZONE
Measurement of residual stresses by x ray diffraction near simulated heat affected zones in austenitic stainless steels
[DE91-008874] N91-21289
HEAT EXCHANGERS
Development of a low noise 10 KJ-T refrigeration system
[AD-A231383] N91-21392
Development of a low noise 10K J-T refrigeration system
[AD-A231461] N91-21393
Dynamic tube/support interaction in heat exchanger tubes
[DE91-006089] N91-21582
HEAT GENERATION
Supervision of peat stockpiles using aerial thermography
[DE91-752966] N91-21622
HEAT OF COMBUSTION
Heats of explosion at low pressures, 2
[AD-A231020] N91-21328
HEAT PIPES
Heat tube device
[NASA-CASE-KSC-11395-1-CU] N91-21473
HEAT RESISTANT ALLOYS
An evaluation of GTAW-P versus GTA welding of alloy 718
[NASA-TM-103529] N91-21287
Elastic response of zone axis (001)-oriented PWA 1480 single crystal: The influence of secondary orientation
[NASA-TM-103782] N91-21558
HEAT SHIELDING
One way to reduce thermal effects in a piezoelectric pressure transducer mounted in the combustion chamber of a C.I. engine
[ISVR-TR-189] N91-21487
HEAT SOURCES
Post-encapsulation plutonia reduction for Galileo and Ulysses GPHS modules: The Module Reduction and Monitoring Facility (MRMF)
[DE91-008131] N91-21861
HEAT TOLERANCE
Ventilation loss and pressurization in the NASA launch/entry suit: Potential for heat stress
[NASA-CR-188075] N91-21719
HEAT TRANSFER
Heat transfer, velocity-temperature correlation, and turbulent shear stress from Navier-Stokes computations of shock wave/turbulent boundary layer interaction flows N91-21085
Zonal analysis of two high-speed inlets N91-21089
A highly efficient engineering tool for three-dimensional scramjet flowfield and heat transfer computations N91-21098
Cooling of in-situ propellant rocket engines for Mars mission
[NASA-TM-103729] N91-21233
Heat-rate improvements obtained with the use of enhanced tubes in surface condensers
[DE91-006565] N91-21449
Heat tube device
[NASA-CASE-KSC-11395-1-CU] N91-21473
Transport in auxiliary-heated, hot-ion H-mode and L-mode discharges in the DIII-D tokamak
[DE91-008924] N91-21887
HEAT TRANSMISSION
Thermal transport studies of optical coatings, interfaces and surfaces by thermal diffusion-wave interferometry
[AD-A231607] N91-21879
HEATERS
Flight motor set 360T010 (STS-31R). Volume 1: System overview
[NASA-CR-184104] N91-21231
HEATING
Deep overheating of thin bodies in flight with very low-angled trajectory
[ISL-R-126/89] N91-21107
A dynamic technique for measuring surface tension at high temperatures in microgravity environment N91-21347
Containerless synthesis of ceramic materials using microwave heating N91-21360
The series Bi2Sr2Ca(n-1) Cu(n)O(2n+4) (1 less than or equal to n less than or equal to 5): Phase stability and superconducting properties
[NASA-TM-103749] N91-21910
HEAVY IONS
Review of CERN heavy-ion physics
[DE91-009326] N91-21844
Characterization of the plasma-switch interaction in the LBL HIF ion source
[DE91-009479] N91-21902
HELICAL WINDINGS
Spectral analysis of the heliotron field with the toroidal harmonic function in a study of the structure of built-in divertor
[NIFS-71] N91-21892
HELICOPTER CONTROL
Results of the HHC wind tunnel tests, 1986 - 1988
[DLR-FB-90-42] N91-21152
Eigenspace design of helicopter flight control systems
[AD-A231588] N91-21153
HELICOPTER DESIGN
Advanced rotorcraft transmission program
[NASA-TM-103276] N91-21531
HELICOPTER PERFORMANCE
Simulation of nap-of-the-Earth flight in helicopters
[NASA-TM-102830] N91-21131
Eigenspace design of helicopter flight control systems
[AD-A231588] N91-21153
HELICOPTER PROPELLER DRIVE
Advanced rotorcraft transmission program
[NASA-TM-103276] N91-21531
HELICOPTER TAIL ROTORS
A study of rotor broadband noise mechanisms and helicopter tail rotor noise
[NASA-CR-177565] N91-21829
HELICOPTERS
A study of rotor broadband noise mechanisms and helicopter tail rotor noise
[NASA-CR-177565] N91-21829
Propagation of helicopter noise in the low atmosphere layers
[ISL-CO-203/90] N91-21830
HELIOTRONS
Observation of parallel viscosity in the CHS heliotron/torsatron
[NIFS-70] N91-21891
Spectral analysis of the heliotron field with the toroidal harmonic function in a study of the structure of built-in divertor
[NIFS-71] N91-21892
HELIUM
Numerical simulation of transverse fuel injection N91-21097
A study of helium. Argon: Ethane gas mixtures used in drift chambers for large acceptance spectrometers in high magnetic fields
[AD-A231209] N91-21284
Theoretical study of the radiative lifetime for the spin-forbidden transition a3 (sigma u +) to X1 (sigma g +) in He2
[AD-A230956] N91-21854
HELMET MOUNTED DISPLAYS
Suppression of biodynamic interference in head-tracked teleoperation
[NASA-TM-103833] N91-21134
HELMETS
A compatibility assessment of the protective integrated hood mask with ANVIS night vision goggles
[AD-A229956] N91-21716
A field evaluation of the compatibility of the protective integrated hood mask with ANVIS night vision goggles
[AD-A230237] N91-21718
HESSIAN MATRICES
Rapidly convergent algorithms for nonsmooth optimization
[AD-A231110] N91-21756
HETERODYNING
Definition of the concept of an interferometric spectrum analyzer for the detection of frequency hopping radios
[AD-A231031] N91-21413
Development of components for submillimeter wave heterodyne radiometers at JPL N91-22017
HETEROGENEITY
A heterogeneous parallel programming capability
[AD-A229710] N91-21772
HETEROJUNCTIONS
Theory of the electronic and optical properties of semiconductor heterostructures
[AD-A231438] N91-21929
HEURISTIC METHODS
Determining concurrency in object-oriented design of real-time embedded systems using Ada
[AD-A230659] N91-21738
An endorsement-based approach to student modeling for planner-controlled intelligent tutoring systems
[NASA-CR-188177] N91-21739
HIERARCHIES
Comparing structurally different views of a VLSI design
[PB91-111757] N91-21425
HIGH ACCELERATION
High G physiological protection training
[AGARD-AG-322] N91-21720
HIGH CURRENT
Broad-beam, high current, metal ion implantation facility
[DE91-009329] N91-21291
High current photoemission with 10 picosecond UV pulses
[DE91-009439] N91-21515
HIGH ENERGY ELECTRONS
Study of relativistic electrons at channeling in a beryllium thick crystals
[DE91-619859] N91-21909
HIGH ENERGY FUELS
Theoretical investigation of energy storage in atomic and molecular systems: Metastable molecular fuels
[AD-A230854] N91-21852
HIGH ENERGY INTERACTIONS
Strange particles production and absorption in nuclei at high energies
[DE91-620399] N91-21845
Chaotic spectra of small molecules
[AD-A231638] N91-21859

Corrections to the participant-spectator model of high-energy alpha-particle fragmentation
[NASA-TM-4262] N91-21860

HIGH FIELD MAGNETS
Chemical spray pyrolysis of Tl-Ba-Ca-Cu-O high-T(sub c) superconductors for high-field bitter magnets N91-21212

HIGH FREQUENCIES
Experimental laboratory system to generate high frequency test environments
[DE91-008252] N91-21583
High-frequency acoustic scattering
[AD-A230880] N91-21836

HIGH GRAVITY ENVIRONMENTS
The development of perceptual/motor and cognitive performance measures under a high-G environment: A preliminary study
[AD-A231289] N91-21709

HIGH LEVEL LANGUAGES
Implementation of FFT and pulse compression routines on the SPT frequency domain array processor
[AD-A231320] N91-21443

HIGH POLYMERS
Tractable high performance polymers
[AD-A231072] N91-21320

HIGH PRESSURE
High-pressure promoted combustion chamber
[NASA-CASE-MSC-21470-1] N91-21157
Spark-ignited diesel engine
[AD-A230243] N91-21533
Physical property measurements on analog granites related to the joint verification experiment
[AD-A230571] N91-21650

HIGH RESOLUTION
High resolution beamforming on large aperture vertical line arrays: Processing synthetic data
[AD-A231054] N91-21415
Beam line and associated work
[AD-A231243] N91-21867

HIGH REYNOLDS NUMBER
The 3D computation of single-expansion-ramp and scramjet nozzles N91-21092

HIGH SPEED
The direct simulation of high-speed mixing-layers without and with chemical heat release N91-21095
On the nonlinear stability of a high-speed, axisymmetric boundary layer
[NASA-CR-187538] N91-21099

HIGH STRENGTH STEELS
Formation of controlled adiabatic shear bands in AISI 4340 high strength steel
[AD-A230999] N91-21300

HIGH TEMPERATURE
High temperature deformation of silicon
[DE91-009102] N91-21305
Elastomer compatibility with liquid propellant at elevated temperature
[AD-A230973] N91-21327
Containerless experiments in fluid physics in microgravity N91-21341
Real-time measurement of materials properties at high temperatures by laser produced plasmas N91-21342
NCTM of liquids at high temperatures using polarization techniques N91-21345
A dynamic technique for measuring surface tension at high temperatures in microgravity environment N91-21347
High-temperature metal purification using a compact, portable rf heating and levitation system on the wake shield N91-21363
High temperature metal purification using a compact portable rf heating and levitation system on the wake shield N91-21365
Optical property measurements as a diagnostic tool for control of materials processing in space and on Earth N91-21366
A high temperature thermal diffusivity determination procedure for solids and liquids N91-21377
Flexible diaphragm-extreme temperature usage
[NASA-CASE-MSC-20797-2] N91-21494

HIGH TEMPERATURE ENVIRONMENTS
Formation of controlled adiabatic shear bands in AISI 4340 high strength steel
[AD-A230999] N91-21300
A high-speed spatial (linear) scanning pyrometer: A tool for diagnostics, temperature mapping, and property determinations at high temperatures N91-21361
Electro optical system to measure strains at high temperature
[NASA-CR-188148] N91-21492

HIGH TEMPERATURE GASES
Hot gas ingestion test results of a two-poster vectored thrust concept with flow visualization in the NASA Lewis 9- x 15-foot low speed wind tunnel
[NASA-TM-103258] N91-21116

HIGH TEMPERATURE PROPELLANTS
Elastomer compatibility with liquid propellant at elevated temperature
[AD-A230973] N91-21327

HIGH TEMPERATURE SUPERCONDUCTORS
Reduction in bearing size due to superconductors in magnetic bearings N91-21211
Chemical spray pyrolysis of Tl-Ba-Ca-Cu-O high-T(sub c) superconductors for high-field bitter magnets N91-21212
The series Bi2Sr2Ca(n-1) Cu(n)O(2n+4) (1 less than or equal to n less than or equal to 5): Phase stability and superconducting properties
[NASA-TM-103749] N91-21910

HIGH VACUUM
Containerless experiments in fluid physics in microgravity N91-21341

HILBERT TRANSFORMATION
Silicon hybrid Wafer Scale Integration (WSI) used to fabricate a Hilbert transform integrated circuit module
[AD-A230605] N91-21428

HISTORIES
Historical evidence for a connection between volcanic eruptions and climate change N91-21642

HOLDERS
Sample holder support for microscopes
[NASA-CASE-MFS-28420-1] N91-21545

HOLLOW CATHODES
Plasma contactor research, 1990
[NASA-CR-187097] N91-21880

HOLOGRAPHIC INTERFEROMETRY
An experimental investigation of circulation control flow fields using holographic interferometry
[NASA-CR-166482] N91-21459

HOLOGRAPHY
X ray laser holography of biological microstructures
[DE91-008732] N91-21488
Very high speed holographic message routing for parallel machines
[AD-A230965] N91-21499
Holographic lens for wide field-of-view laser communication receiver
[AD-A231620] N91-21502

HONEYCOMB CORES
A novel method of testing the shear strength of thick honeycomb composites
[NASA-TP-3108] N91-21242

HONEYCOMB STRUCTURES
A novel method of testing the shear strength of thick honeycomb composites
[NASA-TP-3108] N91-21242
Determination of the flight hardware configuration of an energy absorbing attenuator for the proposed Space Station crew and equipment translation aid cart
[NASA-TP-3084] N91-21556

HORN ANTENNAS
SCUBA: A submillimetre camera N91-22044

HOT ISOSTATIC PRESSING
Mechanical strength and thermophysical properties of PM212: A high temperature self-lubricating powder metallurgy composite
[NASA-TM-103694] N91-21302

HOT-FILM ANEMOMETERS
Constant-current stagnation-point film-anemometer probe
[AD-A231046] N91-21501

HOT-WIRE FLOWMETERS
Slant hot-wire inclination measurement using dual laser beams
[NAL-TR-1078] N91-21491

HUBBLE DIAGRAM
Can non-Gaussian fluctuations for structure formation arise from inflation
[DE91-009458] N91-21655

HUMAN FACTORS ENGINEERING
Exploring the living universe: A strategy for space life sciences
[NASA-TM-103399] N91-21696
National plan for aviation human factors, volume 1
[PB91-100339] N91-21712
National plan for aviation human factors, volume 2
[PB91-100347] N91-21713
Human factors in aviation: Terminal control area boundary conflicts
[NASA-CR-177522] N91-21714

HUMAN PERFORMANCE
Human factors in aviation: Terminal control area boundary conflicts
[NASA-CR-177522] N91-21714
Acquisition and production of skilled behavior in dynamic decision-making tasks
[NASA-CR-188084] N91-21939

HUMAN TOLERANCES
Physiology data acquisition system description
[AD-A231088] N91-21706

HUMIDITY
Satellite-derived moisture-bogusing profiles for the Northwest Pacific Ocean
[AD-A231058] N91-21690
Recommended carbon dioxide and relative humidity levels for maintaining acceptable indoor air quality
[AD-A230026] N91-21717

HYBRID STRUCTURES
Effect of strain rate on the through-thickness elastic properties of woven laminates N91-21245

HYDRAULIC TEST TUNNELS
Transition and turbulence
[ESA-TT-1219] N91-21465

HYDRAZINES
Electronic and ionic transport in processable conducting polymers
[AD-A231293] N91-21321

HYDROCARBON FUELS
Heavy hydrocarbon main injector technology program
[NASA-CR-188082] N91-21235

HYDROCARBONS
Laser probes of natural gas ignition chemistry
[PB91-127993] N91-21262
Flow visualization ion helicopter blades using Acenaphthen
[DLR-FB-90-37] N91-21466

HYDRODYNAMIC EQUATIONS
Transport via moments of quantum distribution functions
[AD-A231182] N91-21821

HYDRODYNAMICS
A comparison of calculational results with experimental data for long rod projectiles
[DE91-009006] N91-21536
Dip coating of sol-gels
[DE91-007571] N91-21872

HYDROGEN
Numerical simulation of transverse fuel injection N91-21097
On the dynamics of the combustion process of hydrogen-air and hydrogen-methane-air mixtures
[ESA-TT-1198] N91-21268
Photoassisted reaction of H2 with CO2 over solid catalysts
[AD-A231045] N91-21282

HYDROGEN ATOMS
First principles theory of the interaction of hydrogen with surfaces and bulk of transition metals
[AD-A231248] N91-21285

HYDROGEN BONDS
Synthesis, structure, and properties of segmented polyurethanes
[AD-A230966] N91-21319

HYDROGEN ENGINES
Evaluation of air injection in a sudden expansion diffuser for real-time afterburning application
[AD-A230850] N91-21141

HYDROGEN FUELS
Preliminary calibration of a generic scramjet combustor
[NASA-CR-187539] N91-21139
Evaluation of air injection in a sudden expansion diffuser for real-time afterburning application
[AD-A230850] N91-21141

HYDROGEN IONS
Review of negative hydrogen ion sources
[DE91-009461] N91-21848
Measurements of scattering processes in negative ion-atom collisions
[DE91-009514] N91-21849

HYDROGEN OXYGEN ENGINES
The energy source rocket of the Soviet Union
[AD-A224938] N91-21229
Advanced expander test bed program
[NASA-CR-187082] N91-21234

HYDROGENATION
Control of catalytic hydrotreating selectivity with ammonia
[DE91-008405] N91-21272
Theory of structure and properties of hydrogenated amorphous silicon
[DE91-009353] N91-21315

HYDROGRAPHY
WINTER 1990 hydrographics data report: CTD station profiles, sections, nutrients, SAIL, January - February 1990
[DE91-008286] N91-21686

HYDROLOGY
Using climate model output to assess the impacts of climate change on water resources
[DE91-004542] N91-21637

HYDROPHONES
A 200 Hz matched field processing on the September 1987 VLA data set
[AD-A231096] N91-21692

HYDROSTATICS
Physical property measurements on analog granites related to the joint verification experiment
[AD-A230571] N91-21650
HYPERBOLIC DIFFERENTIAL EQUATIONS
Functional specifications for mathematical computations
[DE91-006002] N91-21803
HYPERCUBE MULTIPROCESSORS
Domain decomposition methods in computational fluid dynamics
[NASA-CR-187529] N91-21457
Graphical representation of parallel algorithmic processes
[AD-A231258] N91-21760
An automatic parallelization tool for sequential programs
[AD-A229972] N91-21771
Structural analysis on massively parallel computers
[DE91-009038] N91-21773
Hypercube clock synchronization
[DE91-009222] N91-21774
Fuzzy associative memories N91-21779
HYPERSONIC FLIGHT
CFD for hypersonic propulsion
[NASA-TM-103791] N91-21447
Application of computational fluid dynamics in high speed aeropropulsion
[NASA-TM-103780] N91-21458
HYPERSONIC FLOW
Recent update of the RPLUS2D/3D codes N91-21094
Deep overheating of thin bodies in flight with very low-angled trajectory
[ISL-R-126/89] N91-21107
Investigation of nose bluntness and angle of attack effects on slender bodies in viscous hypertension flows
[NASA-CR-188153] N91-21117
Preliminary calibration of a generic scramjet combustor
[NASA-CR-187539] N91-21139
HYPERSONIC INLETS
Two and three-dimensional shock-shock interactions on the blunt leading edges of the hypersonic inlets N91-21088
HYPERSONIC SPEED
Graduate fellowship in hypersonics
[AD-A231263] N91-21478
HYPERSONIC VEHICLES
Bifurcation analysis of the longitudinal dynamics of a simple powered lifting hypersonic vehicle
[AD-A230826] N91-21118
HYPERSONIC WIND TUNNELS
Constant-current stagnation-point film-anemometer probe
[AD-A231048] N91-21501
HYPERSONICS
CFD for hypersonic propulsion
[NASA-TM-103791] N91-21447
HYPERTHERMIA
Ventilation loss and pressurization in the NASA launch/entry suit: Potential for heat stress
[NASA-CR-188075] N91-21719
HYPERVELOCITY GUNS
Advantage of nonguided hypervelocity projectiles in antimissile warfare
[ISL-R-110/90] N91-21174
HYPERVELOCITY PROJECTILES
Advantage of nonguided hypervelocity projectiles in antimissile warfare
[ISL-R-110/90] N91-21174
HYPOBARIC ATMOSPHERES
An annotated bibliography of hypobaric decompression sickness research conducted at the Crew Technology Division, USAF School of Aerospace Medicine, Brooks AFB, Texas from 1983 to 1988
[AD-A231355] N91-21710
HYSTERESIS
Physical property measurements on analog granites related to the joint verification experiment
[AD-A230571] N91-21650

I

IBM COMPUTERS
VM-CMS tutorial
[DE91-009444] N91-21725
ICE FORMATION
Analysis of three icing test flights reaching the aircraft-referred icing degree severe
[DLR-FB-90-34] N91-21123
Impact of icing on Unmanned Aerial Vehicle (UAV) operations
[AD-A231191] N91-21124
IDENTIFYING
Identification of linear multivariable systems from a single set of data by identification of observers with assigned real eigenvalues
[NASA-TM-102669] N91-21575
IGNITERS
Flight set 360L007 (STS-33) insulation component. Volume 3: Final release
[NASA-CR-184091] N91-21230
Flight motor set 360T010 (STS-31R). Volume 1: System overview
[NASA-CR-184104] N91-21231
IGNITION
Flight motor set 360T010 (STS-31R). Volume 1: System overview
[NASA-CR-184104] N91-21231
Laser probes of natural gas ignition chemistry
[PB91-127993] N91-21262
Spray combustion modeling and evaluation
[DE91-007923] N91-21264
IGNITION LIMITS
On the dynamics of the combustion process of hydrogen-air and hydrogen-methane-air mixtures
[ESA-TT-1198] N91-21268
IGNITION SYSTEMS
Spark-ignited diesel engine
[AD-A230243] N91-21533
IMAGE ANALYSIS
Specification of the autonomous missile guidance problem for the TA11 processor. Volume 6: Specification mode 16, N
[FFI-90/4005-VOL-6] N91-21146
Specification of the autonomous missile guidance problem for the TA11 processor. Volume 7: Specification mode 29, N + A + T + H
[FFI-90/4005-VOL-7] N91-21147
Specification of the autonomous missile guidance problem for the TA11 processor. Volume 8: Specification mode 30, N + A + T + B
[FFI-90/4005-VOL-8] N91-21148
Spatial variations in ac susceptibility and microstructure for the YBa2Cu3O(7-x) superconductor and their correlation with room-temperature ultrasonic measurements
[NASA-TM-103787] N91-21553
Introduction to digital imagery processing
[INPE-5212-MD/46] N91-21612
Satellite-derived moisture-bogusing profiles for the Northwest Pacific Ocean
[AD-A231058] N91-21690
IMAGE ENHANCEMENT
Introduction to digital imagery processing
[INPE-5212-MD/46] N91-21612
IMAGE MOTION COMPENSATION
Electro optical system to measure strains at high temperature
[NASA-CR-188148] N91-21492
IMAGE PROCESSING
Specification of the autonomous missile guidance problem for the TA11 processor. Volume 4: Processor mini-spec
[FFI-90/4005-VOL-4] N91-21145
Specification of the autonomous missile guidance problem for the TA11 processor. Volume 6: Specification mode 16, N
[FFI-90/4005-VOL-6] N91-21146
Specification of the autonomous missile guidance problem for the TA11 processor. Volume 7: Specification mode 29, N + A + T + H
[FFI-90/4005-VOL-7] N91-21147
Specification of the autonomous missile guidance problem for the TA11 processor. Volume 8: Specification mode 30, N + A + T + B
[FFI-90/4005-VOL-8] N91-21148
Introduction to digital imagery processing
[INPE-5212-MD/46] N91-21612
Discrimination of lithological units in the lower Valley of the Curaca River (Bahia), through enhancement of digital processing of MSS-LANDSAT-3 data
[INPE-5120-RPE/627] N91-21613
Production of image proportions through a linear mixing model
[INPE-5170-PRE/1639] N91-21615
Implementation in two classes of C (++) for morphological processing of images
[INPE-5217-RPE/642] N91-21744
Application of Fourier-Fresnel imaging to neutral-atom interferometry
[AD-A231154] N91-21857
Scan-line methods in spatial data systems
[AD-A231165] N91-21973
IMAGE RECONSTRUCTION
Image recovery by simulated annealing
[AD-A230655] N91-21869
IMAGING SPECTROMETERS
The MPE/UCB Far-Infrared imaging Fabry-Perot Interferometer (FIFI) N91-22005
IMAGING TECHNIQUES
Description of the Large-Gap Magnetic Suspension System (LGMSS) ground based experiment N91-21200
The metrology of spherical shells using synchrotron x ray microtomography N91-21374
A system for the real-time display of radar and video images of targets
[NASA-CR-186058] N91-21394
Comparison of UNL laser imaging and sizing system and a phase Doppler system for analyzing sprays from a NASA nozzle
[NASA-CR-185239] N91-21485
Nondestructive imaging of materials microstructure using x ray tomographic microscopy
[DE91-008505] N91-21554
Production of image proportions through a linear mixing model
[INPE-5170-PRE/1639] N91-21615
A field evaluation of the compatibility of the protective integrated hood mask with ANVIS night vision goggles
[AD-A230237] N91-21718
Designing a training tool for imaging mental models
[NASA-CR-187891] N91-21776
Application of Fourier-Fresnel imaging to neutral-atom interferometry
[AD-A231154] N91-21857
Advanced, time-resolved imaging techniques for electron-beam characterizations
[DE91-008587] N91-21865
New materials and new techniques for imaging of long wavelength IR radiation
[AD-A231086] N91-21877
The MPE/UCB Far-Infrared imaging Fabry-Perot Interferometer (FIFI) N91-22005
An active telescope for the sub-millimetre balloon-borne project PRONAOS N91-22038
Image quality of the PRONAOS telescope N91-22039
IMIDES
Synthesis of imide/arylene ether copolymers for adhesives and composite matrices
[NASA-TM-104067] N91-21306
Imide/arylene ether block copolymers
[NASA-TM-104066] N91-21308
IMPACT ACCELERATION
Physiology data acquisition system description
[AD-A231088] N91-21706
IMPACT DAMAGE
The micrometeoroid impact hazard in space: Techniques for damage simulation by pulsed lasers and environmental modelling N91-21220
A novel method of testing the shear strength of thick honeycomb composites
[NASA-TP-3108] N91-21242
Impact damage in curved graphite/epoxy panels with clamped edges
[AD-A230853] N91-21257
IMPACT LOADS
Modelling of the impact response of fibre-reinforced composites
[OUEL-1863/90] N91-21244
Mechanical behaviour of composite materials under impact loading N91-21250
IMPACT RESISTANCE
Modelling of the impact response of fibre-reinforced composites
[OUEL-1863/90] N91-21244
A new type of shear specimen for measuring the interlaminar shear strength under impact loading N91-21246
IMPACT TESTS
A novel method of testing the shear strength of thick honeycomb composites
[NASA-TP-3108] N91-21242
Modelling of the impact response of fibre-reinforced composites
[OUEL-1863/90] N91-21244
The interlaminar shear strength of woven carbon, woven glass and woven carbon/glass hybrid laminates under static and impact loading N91-21247
Impact damage in curved graphite/epoxy panels with clamped edges
[AD-A230853] N91-21257
IMPACT TOLERANCES
A novel method of testing the shear strength of thick honeycomb composites
[NASA-TP-3108] N91-21242
IMPEDANCE
The use of a scanning electrochemicl impedance spectroscopy technique to investigate localized corrosion
[DE91-006918] N91-21296

Numerical recovery of certain discontinuous electrical conductivities
[NASA-CR-187543] N91-21800

IMPINGEMENT
Two and three-dimensional shock-shock interactions on the blunt leading edges of the hypersonic inlets N91-21088

IMPULSES
Optimal Hankel-norm approximation and rational function models using impulse response data
[AD-A231317] N91-21839

IMPURITIES
Recent JET results and future prospects
[DE91-005474] N91-21897
Observation of spectral diffusion in crystals using single impurity molecules
[AD-A231338] N91-21926

INCIDENCE
A simple model vortex flow past a slender elliptic cone at incidence
[RAE-TM-AERO-2197] N91-21460

INCOHERENCE
Coherent and incoherent detection N91-22010

INCOHERENT SCATTERING
Application of the finite element method to random rough surface scattering with Neumann boundary conditions
[AD-A231583] N91-21420

INCOMPRESSIBLE FLOW
A pressure based method for the solution of viscous incompressible turbomachinery flows N91-21078
The direct simulation of high-speed mixing-layers without and with chemical heat release N91-21095
On the anomaly of velocity-pressure decoupling in collocated mesh solutions
[NASA-TM-103769] N91-21448

INDENTATION
Tribological performance and deformation of sputter-deposited MoS2 solid lubricant films during sliding wear and indentation contact
[AD-A231003] N91-21547

INDIUM COMPOUNDS
Ex-situ and in-situ ellipsometric studies of the thermal oxide on InP
[AD-A231095] N91-21283

INDIUM PHOSPHATES
Ex-situ and in-situ ellipsometric studies of the thermal oxide on InP
[AD-A231095] N91-21283

INDIUM PHOSPHIDES
Ex-situ and in-situ ellipsometric studies of the thermal oxide on InP
[AD-A231095] N91-21283
Optimal design study of high efficiency indium phosphide space solar cells
[NASA-TM-103763] N91-21433

INDOLES
Comparison of the activity of subsurface and surface microorganisms and their anaerobic transformation of heterocyclic compounds
[DE91-008839] N91-21703

INDOOR AIR POLLUTION
Recommended carbon dioxide and relative humidity levels for maintaining acceptable indoor air quality
[AD-A230026] N91-21717

INDUSTRIAL MANAGEMENT
Top quality management, reliability, and maintainability: Institutional goals with built in barriers
[AD-A230134] N91-21552

INDUSTRIES
From Earth to space and back: Selected papers on Norwegian space activities
[NSC-REPT(90)2] N91-21159
Development of Norwegian space activities N91-21160
How clean is clean. How clean is needed
[DE91-008173] N91-21391

INELASTIC SCATTERING
Electron distortion effects in quasi-elastic electron scattering
[DE91-009034] N91-21843

INERTIAL CONFINEMENT FUSION
The metrology of spherical shells using synchrotron x ray microtomography N91-21374
Characterization of the plasma-switch interaction in the LBL HIF ion source
[DE91-009479] N91-21902

INERTIAL GUIDANCE
Identification of parameters derived from inertial sensors
[INPE-5166-RPE/637] N91-21746

INFERENCE
The simplification of fuzzy control algorithm and hardware implementation N91-21781
Learning control of inverted pendulum system by neural network driven fuzzy reasoning: The learning function of NN-driven fuzzy reasoning under changes of reasoning environment N91-21785
Experiments on neural network architectures for fuzzy logic N91-21787

INFORMATION
Promoting a healthy skepticism with regard to information processing
[DE91-007697] N91-21968

INFORMATION DISSEMINATION
Transportation telecommunications
[PB91-123257] N91-21399
NASA/DoD aerospace knowledge diffusion research project. Paper 9: Information intermediaries and the transfer of aerospace Scientific and Technical Information (STI). A report from the field
[NASA-TM-103384] N91-21959
Third Information Transfer Meeting
[PB91-123922] N91-21961
Aeronautics and space technology N91-21981

INFORMATION FLOW
NASA/DoD aerospace knowledge diffusion research project. Paper 9: Information intermediaries and the transfer of aerospace Scientific and Technical Information (STI). A report from the field
[NASA-TM-103384] N91-21959

INFORMATION MANAGEMENT
Experiment Document Information System (EDIS) evolution N91-21941

INFORMATION RETRIEVAL
An annotated bibliography of hypobaric decompression sickness research conducted at the Crew Technology Division, USAF School of Aerospace Medicine, Brooks AFB, Texas from 1983 to 1988
[AD-A231355] N91-21710
Life sciences on-line: A study in hypermedia application N91-21943
Computer-assisted knowledge acquisition for hypermedia systems N91-21944
SEPEC conference proceedings: Hypermedia and Information Reconstruction. Aerospace applications and research directions. Addendum
[NASA-CR-187936] N91-21955
A knowledge base browser using hypermedia N91-21956

INFORMATION SYSTEMS
Experiment Document Information System (EDIS) evolution N91-21941
Administrative information systems plan, FY 1991 - FY 1995
[DE91-008072] N91-21964
Relational databases with NIAM models bid so long to top-down designs
[DE91-009191] N91-21965

INFORMATION THEORY
Noise effects upon a simple timing channel
[AD-A230818] N91-21726
Continuation and bifurcation investigations in constrained optimization
[AD-A231639] N91-21769

INFORMATION TRANSFER
NASA/DoD aerospace knowledge diffusion research project. Paper 9: Information intermediaries and the transfer of aerospace Scientific and Technical Information (STI). A report from the field
[NASA-TM-103384] N91-21959
Third Information Transfer Meeting
[PB91-123922] N91-21961

INFRARED ASTRONOMY
Submillimeter observations with the Kuiper Airborne Observatory N91-21987
Japanese space programmes of IR and sub-mm astronomy N91-21997
Millimeter observations of a complete sample of galaxies: Implications for gas mass and cold dust component N91-21999
SOFIA: The Stratospheric Observatory For Infrared Astronomy N91-22003
The MPE/UCB Far-Infrared imaging Fabry-Perot Interferometer (FIFI) N91-22005
Far-infrared heterodyne technology N91-22016
The OASI observatory in Antarctica N91-22036
Radiatively-cooled telescopes for infrared space astronomy N91-22048

INFRARED ASTRONOMY SATELLITE
Millimeter observations of a complete sample of galaxies: Implications for gas mass and cold dust component N91-21999
The 0 deg (63 micron) line emission from galactic high latitude cirrus clouds N91-22029

INFRARED DETECTORS
AEDC focal plane array test capability
[AD-A230846] N91-21408
Laterally stacked Schottky diodes for infrared sensor applications
[NASA-CASE-NPO-17426-1-CU] N91-21434
Background issues for defensive interceptors
[DE91-009219] N91-21819
Research in optical sciences
[AD-A230964] N91-21875
The MPE/UCB Far-Infrared imaging Fabry-Perot Interferometer (FIFI) N91-22005

INFRARED IMAGERY
Infrared thermography for the qualitative aerodynamic study of a slender body
[ISL-R-122/89] N91-21104
Cloud classification of DMSP visible and IR imagery using physical and textural features
[AD-A231186] N91-21680
New materials and new techniques for imaging of long wavelength IR radiation
[AD-A231086] N91-21877

INFRARED LASERS
Toward high brightness, multi-kilowatt solid state lasers
[DE91-008990] N91-21504

INFRARED RADIATION
Efficient approaches for report/cluster correlation in multitarget tracking systems
[AD-A231589] N91-21421
Background issues for defensive interceptors
[DE91-009219] N91-21819

INFRARED SPACE OBSERVATORY (ISO)
Performance tests on Ge:Ga and Ge:Be detectors for the ISO long wavelength spectrometer N91-22045

INFRARED SPECTRA
Preparation and characterization of Iron(III) oxide films by an novel spray pyrolysis method
[AD-A231047] N91-21920
The 0 deg (63 micron) line emission from galactic high latitude cirrus clouds N91-22029

INFRARED SPECTROSCOPY
The (C II) 158 micron line mapping of spiral galaxies N91-21996

INFRARED TELESCOPES
A millimeter and submillimeter balloon telescope for measurements of diffuse radiation N91-22040
The TIR project: A balloon telescope for the measurement of CBR anisotropies N91-22041
Radiatively-cooled telescopes for infrared space astronomy N91-22048

INHOMOGENEITY
Effect of electric field inhomogeneities on drift wave instabilities and anomalous transport
[NIFS-72] N91-21893

INJECTION
High density regimes and beta limits in JET
[DE91-005490] N91-21885

INJECTORS
Heavy hydrocarbon main injector technology program
[NASA-CR-188082] N91-21235

INLET FLOW
A pressure flux-split technique for computation of inlet flow behavior N91-21068
Zonal analysis of two high-speed inlets N91-21089
Hot gas ingestion test results of a two-poster vectored thrust concept with flow visualization in the NASA Lewis 9- x 15-foot low speed wind tunnel
[NASA-TM-103258] N91-21116

INORGANIC COMPOUNDS
A systematic investigation of the preparation and properties of composite carbon molecular sieves containing inorganic oxides N91-21353

INPUT/OUTPUT ROUTINES
Utilization of GPIOP in the matrix processor FPS-5410
[INPE-5152-RPE/634] N91-21747

INSPECTION
Flight motor set 360T010 (STS-31R). Volume 1: System overview
[NASA-CR-184104] N91-21231

INSTRUMENT COMPENSATION
Nonlinear compensation techniques for magnetic suspension systems N91-21204
Electro optical system to measure strains at high temperature
[NASA-CR-188148] N91-21492

INSULATION
Flight set 360L007 (STS-33) insulation component. Volume 3: Final release
[NASA-CR-184091] N91-21230
Nonlinear optical spectroscopy of Ce3(+) ions in insulating crystals
[DE91-008928] N91-21913

INSULATORS
Enhanced single layer multi-color or luminescent display with coactivators
[NASA-CASE-LAR-14181-1] N91-21911

INTEGRATED CIRCUITS
Silicon hybrid Wafer Scale Integration (WSI) used to fabricate a Hilbert transform integrated circuit module [AD-A230605] N91-21428
Test results of a 90 MHz integrated circuit sixteen channel analog pipeline for SSC detector calorimetry [DE91-009773] N91-21436
Single board system for fuzzy inference N91-21784
The necessity for a DOD capability in superconducting electronics [AD-A231553] N91-21931
INTEGRITY
Mechanical strain isolator mount [NASA-CASE-LAR-13580-1] N91-21541
INTERACTIONAL AERODYNAMICS
Computation of laminar viscous-inviscid interactions in high-speed internal flows N91-21087
Two and three-dimensional shock-shock interactions on the blunt leading edges of the hypersonic inlets N91-21088
Acoustic and aerodynamic study of a pusher-propeller aircraft model [NASA-TP-3040] N91-21828
INTERCEPTORS
Threat modernization in the near term [DE91-009228] N91-21817
Background issues for defensive interceptors [DE91-009219] N91-21819
INTERFACES
A modified SLIC material interface reconstruction algorithm for Eulerian codes [DE91-009175] N91-21740
A remote visual interface tool for simulation control and display [AD-A231019] N91-21754
An automatic parallelization tool for sequential programs [AD-A229972] N91-21771
Structural characterization of the Ag/YBa2Cu3O(7-x) interface [DE91-009112] N91-21907
INTERFACIAL ENERGY
Strength of polymer interfaces [AD-A230839] N91-21318
Critical behavior in magnetic superlattices [AD-A231327] N91-21925
INTERFACIAL TENSION
Surface tension and viscosity from damped free oscillations of viscous droplets N91-21346
A dynamic technique for measuring surface tension at high temperatures in microgravity environment N91-21347
INTERFEROMETERS
The single antenna interferometer [DE91-007128] N91-21407
Automatic program correction of interferometry quadratic sensor errors. Application to the processing of signals from a VISAR interferometer [ISL-R-127/89] N91-21799
Fiber optic sensing system [NASA-CASE-LEW-14795-1] N91-21871
INTERFEROMETRY
The single antenna interferometer [DE91-007128] N91-21407
Application of Fourier-Fresnel imaging to neutral-atom interferometry [AD-A231154] N91-21857
Thermal transport studies of optical coatings, interfaces and surfaces by thermal diffusion-wave interferometry [AD-A231607] N91-21879
INTERGALACTIC MEDIA
Submillimeter astronomy and cosmological tests N91-21993
Submillimeter observations of extragalactic objects in the wavelength range 50 microns to 1 mm N91-21994
INTERNAL COMBUSTION ENGINES
Simulation of chemical kinetics in combustion [DE91-008446] N91-21273
Use of natural gas and liquefied petroleum gas in heavy-duty engines [DE91-752990] N91-21546
INTERNAL WAVES
Power spectra of internal gravity waves [AD-A231596] N91-21659
Interaction of surface waves and near surface currents [AD-A231612] N91-21694
INTERNATIONAL COOPERATION
Report of the panel on international programs N91-21599
Bibliography on the international network of biosphere reserves [PB90-215518] N91-21600
INTERPOLATION
Uniform high order spectral methods for one and two dimensional Euler equations [NASA-CR-187535] N91-21456
INTERPROCESSOR COMMUNICATION
Noise effects upon a simple timing channel [AD-A230818] N91-21726
On the massively parallel solution of the assignment problem [AD-A230847] N91-21775
INTERSTELLAR CHEMISTRY
Interstellar chemistry and submillimetre astronomy N91-22021
First detection of C3H2 at sub-mm wavelengths N91-22022
The submillimeter wave astronomy satellite N91-22025
INTERSTELLAR MASERS
Excitation of submillimeter water masers N91-22024
INTERSTELLAR MATTER
Analysis and interpretation of diffuse x-ray emission using data from the Einstein satellite [NASA-CR-187988] N91-21728
Submillimeter observations of extragalactic objects in the wavelength range 50 microns to 1 mm N91-21994
Millimeter observations of a complete sample of galaxies: Implications for gas mass and cold dust component N91-21999
Large-scale (CII) 158 micron emission of the Galaxy observed by a balloon-borne telescope N91-22004
The stucture of molecular clouds: New questions N91-22011
Interstellar chemistry and submillimetre astronomy N91-22021
Submillimeter water masers at 321 and 325 GHz N91-22023
Excitation of submillimeter water masers N91-22024
A high throughput, multiband photometer for the TIR project N91-22042
Submillimetre photometry of comets N91-22052
INVISCID FLOW
Flux-vector splitting for the 1990s N91-21073
Computation of laminar viscous-inviscid interactions in high-speed internal flows N91-21087
Solution of three-dimensional afterbody flow using reduced Navier-Stokes equations N91-21093
Singularities in water waves and Rayleigh-Taylor instability [NASA-CR-187530] N91-21455
Uniform high order spectral methods for one and two dimensional Euler equations [NASA-CR-187535] N91-21456
Finite element methods of analysis for 3D inviscid compressible flows [NASA-CR-186271] N91-21463
General three-dimensional disturbances to inviscid Couette flow [DE91-009593] N91-21474
ION ACCELERATORS
Characterization of the plasma-switch interaction in the LBL HIF ion source [DE91-009479] N91-21902
ION ATOM INTERACTIONS
Measurements of scattering processes in negative ion-atom collisions [DE91-009514] N91-21849
ION BEAMS
Research in optical sciences [AD-A230964] N91-21875
Characterization of the plasma-switch interaction in the LBL HIF ion source [DE91-009479] N91-21902
ION CONCENTRATION
Dependence of the photorefractive properties of KTa(1-x)Nb(x)O3:Cu,V on Cu valence state concentration [AD-A230954] N91-21917
ION IMPLANTATION
Broad-beam, high current, metal ion implantation facility [DE91-009329] N91-21291
EBIC (Electron Beam Induced Current) contrast of clean, decorated and deuterium passivated Si(Ge) epitaxial misfit dislocations [DE91-006967] N91-21912
ION IRRADIATION
Study of asymmetrical electric discharges using particle simulation [INPE-5198-TDL/427] N91-21432
ION SCATTERING
Finding a single molecule in a haystack: Laser spectroscopy of solids from square root of (N to N) = 1 [AD-A230910] N91-21521
ION SOURCES
Review of negative hydrogen ion sources [DE91-009461] N91-21848
Measurements of scattering processes in negative ion-atom collisions [DE91-009514] N91-21849
Characterization of the plasma-switch interaction in the LBL HIF ion source [DE91-009479] N91-21902
ION TEMPERATURE
High performance H modes in JET [DE91-005488] N91-21883
IONIC COLLISIONS
Measurements of scattering processes in negative ion-atom collisions [DE91-009514] N91-21849
IONIZATION
Rapid determination of drugs and semivolatile organics by direct thermal desorption ion trap mass spectrometry [DE91-008885] N91-21278
The study of plasma clouds around large active space structures [AD-A230634] N91-21881
Host materials for 4d(sup N) and 5d(sup N) transition-metal ions [AD-A231606] N91-21933
IONIZING RADIATION
Specificity of mutation induced by ionizing radiation and oxidizing free radicals [DE91-008838] N91-21702
IONOSPHERIC CURRENTS
Variability of the Sq focus position in the South American continent [INPE-4740-PRE/1415] N91-21652
IONOSPHERIC PROPAGATION
Radio wave propagation modeling, prediction and assessment [AGARD-AG-326] N91-21404
IRON
Magnetic quasicrystals [AD-A231264] N91-21924
IRON OXIDES
Preparation and characterization of Iron(III) oxide films by an novel spray pyrolysis method [AD-A231047] N91-21920
IRRADIATION
In vitro photoreactivation of transforming DNA of Bacillus subtilis spores after irradiation by ultraviolet light [ESA-TT-1210] N91-21699
International document on food irradiation [DE91-615879] N91-21715
ISING MODEL
Critical behavior in magnetic superlattices [AD-A231327] N91-21925
ISOLATORS
Mechanical strain isolator mount [NASA-CASE-LAR-13580-1] N91-21541
ISOTROPY
A method for the geometrically nonlinear analysis of compressively loaded prismatic composite structures [NASA-CR-184846] N91-21561
ITERATION
Distributed Minimal Residual (DMR) method for acceleration of iterative algorithms N91-21077
Iterative procedures for exact maximum likelihood estimation in the first-order Gaussian moving average model [AD-A230812] N91-21809
ITERATIVE SOLUTION
Layer tracking asymptotics and domain decomposition [DE91-008593] N91-21462
Iterative procedures for exact maximum likelihood estimation in the first-order Gaussian moving average model [AD-A230812] N91-21809

J

JAMMING
Excision techniques in direct sequence spread spectrum communication systems [AD-A231290] N91-21763
JAPANESE SPACE PROGRAM
Japanese space programmes of IR and sub-mm astronomy N91-21997
JET FLOW
Infrared thermography for the qualitative aerodynamic study of a slender body [ISL-R-122/89] N91-21104
Theoretical investigation of the injection and evaporation of water in a hydrogen/oxygen steam generator [DLR-FB-90-20] N91-21938
JET MIXING FLOW
Numerical simulation of transverse fuel injection N91-21097
JET PROPULSION
Simulation of turbomachinery flows N91-21089

JET VANES
Static thrust-vectoring performance of nonaxisymmetric convergent-divergent nozzles with post-exit yaw vanes [NASA-TP-3085] N91-21059
JOINTS (JUNCTIONS)
Flight set 360L007 (STS-33) insulation component. Volume 3: Final release [NASA-CR-184091] N91-21230
Power optimal single-axis articulating strategies [NASA-CR-187510] N91-21581
JOSEPHSON JUNCTIONS
Requirements for SIS receivers in the 500-1000 GHz region N91-22015
Development of components for submillimeter wave heterodyne radiometers at JPL N91-22017
JOURNAL BEARINGS
Measurement and calculation of forces in a magnetic journal bearing actuator N91-21207
Dynamic modelling and analysis of a magnetically suspended flexible rotor N91-21208
JUNCTION DIODES
The mm and sub-mm wave planar antenna arrays for SIS detectors N91-22046

K

K-EPSILON TURBULENCE MODEL
Computation of supersonic and low subsonic cascade flows using an explicit Navier-Stokes technique and the kappa-epsilon turbulence model N91-21072
Computational modelling of dump combustors flowfield N91-21096
Turbulent separated flow past a backward-facing step: A critical evaluation of two-equation turbulence models [NASA-CR-187532] N91-21451
KALMAN FILTERS
Flight path reconstruction using extended Kalman filtering techniques [DLR-FB-90-41] N91-21108
A preliminary evaluation of an F100 engine parameter estimation process using flight data [NASA-TM-4216] N91-21446
Kalman filter tracking of a reflective target using forward looking infrared measurements and laser illumination [AD-A231196] N91-21524
Analysis, preliminary design and simulation systems for control-structure interaction problems [NASA-CR-188018] N91-21729
Second-order discrete Kalman filtering equations for control-structure interaction simulations [CU-CSSC-91-5] N91-21731
KAPTON (TRADEMARK)
Kapton wire arc track testing: Per test procedure KWATT BB01 [NASA-CR-185642] N91-21427
KINEMATICS
Assessment of the absolute accuracy of long-baseline kinematic GPS positioning of a moving vehicle [PB91-129379] N91-21125
Experiments in cooperative-arm object manipulation with a two-armed free-flying robot [NASA-CR-188028] N91-21529
Method and apparatus for configuration control of redundant robots [NASA-CASE-NPO-17801-1-CU] N91-21544
Application of the p-version FE method to geometrically non-linear problems in three dimensions [FFA-TN-1990-33] N91-21569
KINETIC ENERGY
Notes on space, satellites, and survivability [DE91-009229] N91-21226
KINETICS
Thermodynamic properties and crystallization kinetics at high liquid undercooling N91-21343
Kinetic aspects of lattice mismatch in molecular beam epitaxial growth on planar and patterned substrates [AD-A231636] N91-21934
KLYSTRONS
Transverse klystron [AD-A231586] N91-21444
KNOWLEDGE BASES (ARTIFICIAL INTELLIGENCE)
An endorsement-based approach to student modeling for planner-controlled intelligent tutoring systems [NASA-CR-188177] N91-21739
Using fuzzy logic to integrate neural networks and knowledge-based systems N91-21788
Intelligent array system [AD-A231107] N91-21792
SEPEC conference proceedings: Hypermedia and Infromation Reconstruction. Aerospace applications and research directions [NASA-CR-187935] N91-21940
Computer-assisted knowledge acquisition for hypermedia systems N91-21944
Seven ways to make a hypertext project fail N91-21946
Integrating knowledge and control into hypermedia-based training environments: Experiments with HyperCLIPS N91-21949
A knowledge base browser using hypermedia N91-21956
AiGERM: A logic programming front end for GERM N91-21957
Knowledge base systems in DMA's digital production system [AD-A230771] N91-21963
KNOWLEDGE REPRESENTATION
SEPEC conference proceedings: Hypermedia and Infromation Reconstruction. Aerospace applications and research directions [NASA-CR-187935] N91-21940
Seven ways to make a hypertext project fail N91-21946
The object the metaphor the power and evergreen or the eighth way to make a hypermedia project fail N91-21947
Integrating knowledge and control into hypermedia-based training environments: Experiments with HyperCLIPS N91-21949
GERM as a tool for space station documentation N91-21950
Automating hypertext for decision support N91-21951
Hypermedia as medium N91-21952
Hypermedia = hypercommunication N91-21953
From knowledge presentation to knowledge representation to knowledge construction: Future directions for hypermedia N91-21954
SEPEC conference proceedings: Hypermedia and Information Reconstruction. Aerospace applications and research directions. Addendum [NASA-CR-187936] N91-21955
A knowledge base browser using hypermedia N91-21956
KOLMOGOROFF THEORY
Probability distribution functions in turbulent convection [NASA-CR-187519] N91-21453
KUIPER AIRBORNE OBSERVATORY
Submillimeter observations with the Kuiper Airborne Observatory N91-21987
The (C II) 158 micron line mapping of spiral galaxies N91-21996
KUTTA-JOUKOWSKI CONDITION
Blunt trailing edge analysis of supercritical airfoils by a Navier-Stokes code [NAL-TR-1075-T] N91-21114

L

LABORATORIES
Analytical chemistry laboratory [DE91-008986] N91-21266
FWP executive summaries: Basic energy sciences, materials sciences programs [DE91-009223] N91-21826
LABORATORY EQUIPMENT
Experimental laboratory system to generate high frequency test environments [DE91-008252] N91-21583
LAGRANGE MULTIPLIERS
A monotone decreasing algorithm for the 0-1 multiknapsack dual problem [INPE-5160-RPE/635] N91-21745
LAMINAR BOUNDARY LAYER
Practical methods to evaluate the friction drag coefficient of a projectile in free flight [ISL-R-123/89] N91-21105
An experimental study of a three-dimensional swept-back wing with suction laminar-flow-control [NAL-TR-1072] N91-21113
LAMINAR FLOW
Implicit solution of three-dimensional internal turbulent flows N91-21082
Computation of laminar viscous-inviscid interactions in high-speed internal flows N91-21087
Finite element methods for integrated aerodynamic heating analysis [NASA-CR-188079] N91-21101
Method and apparatus for detecting laminar flow separation and reattachment [NASA-CASE-LAR-13952-2-SB] N91-21472
LAMINATES
Modelling of the impact response of fibre-reinforced composites [OUEL-1863/90] N91-21244
Effect of strain rate on the through-thickness elastic properties of woven laminates N91-21245
A new type of shear specimen for measuring the interlaminar shear strength under impact loading N91-21246
The interlaminar shear strength of woven carbon, woven glass and woven carbon/glass hybrid laminates under static and impact loading N91-21247
Analysis of failure in woven carbon/epoxy laminates under quasi-static and impact loading N91-21248
Delamination and free edge stresses in laminated plates subjected to constant uniaxial strain (computer program) [ESDU-90021] N91-21253
Large deformation behavior of long shallow cylindrical composite panels [NASA-CR-4355] N91-21557
Thermal buckling and postbuckling of symmetrically laminated composite plates [NASA-CR-188030] N91-21560
Mode 1 interlaminar fracture toughness of carbon/PEEK participation in an international round robin program [FFA-TN-1990-41] N91-21570
Stacking-sequence optimization for buckling of laminated plates by integer programming [NASA-TM-104033] N91-21580
LAND MOBILE SATELLITE SERVICE
Application of SAW technology in satellites for mobile services N91-21163
LAND USE
Data integration of different sensor systems through the technique of IHS transformation, the purpose and study of intra-urban structure [INPE-5171-PRE/1640] N91-21616
Characterization of antropic action in the Mearim (MA) middle-low valley through LANDSAT/TM imagery [INPE-5075-PRE/1594] N91-21620
Evaluation of indigenous areas utilizing TM/LANDSAT data [INPE-5173-PRE/1642] N91-21636
LANDAU DAMPING
Effect of electric field inhomogeneities on drift wave instabilities and anomalous transport [NIFS-72] N91-21893
LANDSAT SATELLITES
Spectral responses of soybean and cotton from Landsat/TM digital data [INPE-5179-PRE/1648] N91-21614
LANDSAT 5
Registration of windfall damage in the eastern Hunsrueck Plateau (Fed. Republic of Germany) utilizing LANDSAT TM data: A landscape-ecological analysis for practical forestry [DLR-FB-90-31] N91-21601
Remote sensing estimation of total chlorophyll pigment distribution in Barra Bonita Reservoir [INPE-5202-PRE/1664] N91-21603
LANTHANUM
Growth and characterization of thin films of Y2O3, La2O3 and La2CuO4 [AD-A231046] N91-21919
LAPLACE TRANSFORMATION
A high temperature thermal diffusivity determination procedure for solids and liquids N91-21377
LARGE DEPLOYABLE REFLECTOR
LDR: A submillimeter great observatory N91-22018
FIR and sub-mm direct detection spectrometers for spaceborne astronomy N91-22026
LARGE SPACE STRUCTURES
Torsional suspension system for testing space structures [NASA-CASE-LAR-14149-1-SB] N91-21176
The spacecraft control laboratory experiment optical attitude measurement system [NASA-TM-102624] N91-21186
Model correlation and damage location for large space truss structures: Secant method development and evaluation [NASA-CR-188102] N91-21213
Ground-based testing of the dynamics of flexible space structures using band mechanisms [NASA-CR-188154] N91-21576
Active vibration absorber for CSI evolutionary model: Design and experimental results [NASA-TM-104048] N91-21578
On-orbit damage detection and health monitoring of large space trusses: Status and critical issues [NASA-TM-104045] N91-21579
Parallel computations and control of adaptive structures N91-21732
The study of plasma clouds around large active space structures [AD-A230634] N91-21881
LASER ANEMOMETERS
Comparison of UNL laser imaging and sizing system and a phase Doppler system for analyzing sprays from a NASA nozzle [NASA-CR-185239] N91-21485

LASER APPLICATIONS
Hot gas ingestion test results of a two-poster vectored thrust concept with flow visualization in the NASA Lewis 9- x 15-foot low speed wind tunnel
[NASA-TM-103258] N91-21116
Laser test for spindle parallelism
[DE91-009716] N91-21518
Kalman filter tracking of a reflective target using forward looking infrared measurements and laser illumination
[AD-A231196] N91-21524
LASER BEAMS
High temperature acoustic and hybrid microwave/acoustic levitators for materials processing N91-21368
Slant hot-wire inclination measurement using dual laser beams
[NAL-TR-1078] N91-21491
Holographic lens for wide field-of-view laser communication receiver
[AD-A231620] N91-21502
Optical properties of a nuclear reactor pumped gas laser
[DE91-009226] N91-21507
Design overview of a highly stable infrared free electron laser at LBL
[DE91-009327] N91-21508
Statistical fluctuations in lasers
[DE91-009540] N91-21517
Optical switching and optical logic in a thermally expanding Si etalon
[AD-A230706] N91-21870
Research in optical sciences
[AD-A230964] N91-21875
Transverse flow gas lens
[AD-A231366] N91-21878
LASER CUTTING
Toward high brightness, multi-kilowatt solid state lasers
[DE91-008990] N91-21504
LASER DOPPLER VELOCIMETERS
Comparison of UNL laser imaging and sizing system and a phase Doppler system for analyzing sprays from a NASA nozzle
[NASA-CR-185239] N91-21485
LASER FUSION
The Basis version of LASNEX
[DE91-009483] N91-21516
LASER GYROSCOPES
Angle measurements with the laser gyro GG 1342
[ESA-TT-1212] N91-21490
LASER INDUCED FLUORESCENCE
Laser probes of natural gas ignition chemistry
[PB91-127993] N91-21262
Enhanced selectivity and detectability in absorption and fluorescence methods based on polarization modulation
[DE91-008926] N91-21279
LASER INTERFEROMETRY
Fracture toughness of unidirectional fiber reinforced ceramic composites in Mode 2 utilizing laser interferometry
[AD-A231027] N91-21258
LASER OUTPUTS
Toward high brightness, multi-kilowatt solid state lasers
[DE91-008990] N91-21504
High efficiency surface-emitting semiconductor laser resonators
[DE91-005236] N91-21510
High brightness electron beam production by laser induced various order multiphoton photoeffects of gold
[DE91-009150] N91-21514
Fiber optic sensing system
[NASA-CASE-LEW-14795-1] N91-21871
LASER PLASMAS
Real-time measurement of materials properties at high temperatures by laser produced plasmas N91-21342
The Basis version of LASNEX
[DE91-009483] N91-21516
Laser diagnostics for plasma turbulence
[DE91-009377] N91-21899
Time-resolved extreme-ultraviolet spectroscopy of laser-produced plasmas originating at the parylene layer of microballon targets
[DE91-009378] N91-21900
LASER PROPULSION
Evaluation of transportation systems for advanced spaceflight missions
[DLR-FB-90-39] N91-21181
LASER PUMPING
Proof of the feasibility of coherent and incoherent schemes for pumping a gamma ray laser
[AD-A230897] N91-21520
LASER SPECTROSCOPY
Applications and current limitations of matrix-assisted laser desorption Fourier transform mass spectrometry for biomolecules
[DE91-008877] N91-21265
Enhanced selectivity and detectability in absorption and fluorescence methods based on polarization modulation
[DE91-008926] N91-21279
Finding a single molecule in a haystack: Laser spectroscopy of solids from square root of (N to N) =1
[AD-A230910] N91-21521
Far-infrared heterodyne technology N91-22016
LASER TARGETS
The Basis version of LASNEX
[DE91-009483] N91-21516
Kalman filter tracking of a reflective target using forward looking infrared measurements and laser illumination
[AD-A231196] N91-21524
Time-resolved extreme-ultraviolet spectroscopy of laser-produced plasmas originating at the parylene layer of microballon targets
[DE91-009378] N91-21900
LASER WEAPONS
Requirements for progressive strategic defenses
[DE91-008997] N91-21812
Near-term boost-phase defense sensitivities
[DE91-008999] N91-21813
LASERS
High temperature acoustic and hybrid microwave/acoustic levitators for materials processing N91-21368
Holographic lens for wide field-of-view laser communication receiver
[AD-A231620] N91-21502
Statistical fluctuations in lasers
[DE91-009540] N91-21517
LATTICE PARAMETERS
On the crystal structure of boron carbides
[DE91-009256] N91-21914
LAUNCHERS
Considerations and studies for the construction of acceleration coils for inductive launchers
[ISL-CO-240/89] N91-21173
LAUNCHING SITES
Effectiveness of bomber deployed autonomous airborne vehicles in finding rail mobile SS-24s
[DE91-009008] N91-21815
LAVA
Report of the panel on volcanology, section 4 N91-21593
LAW (JURISPRUDENCE)
Unified agenda of Federal regulations, October 1990
[PB91-120527] N91-21984
LAWS
Science, medicine and animals
[ISBN-0-309-04439-1] N91-21697
LAY-UP
Impact damage in curved graphite/epoxy panels with clamped edges
[AD-A230853] N91-21257
LEAD (METAL)
Multi-core events in cosmic-ray induced interactions with lead at around 10 TeV
[DE91-616827] N91-22062
LEAD ALLOYS
Superplastic creep of eutectic tin-lead solder joints
[DE91-009074] N91-21586
LEARNING
Identification of linear multivariable systems from a single set of data by identification of observers with assigned real eigenvalues
[NASA-TM-102669] N91-21575
First Annual Meeting of International Neural Network Society
[AD-A230283] N91-21777
Acquisition and production of skilled behavior in dynamic decision-making tasks
[NASA-CR-188084] N91-21939
A model for addressing navigation limitations and metacognitive constraints in hypermedia training systems N91-21945
LEAST SQUARES METHOD
Improved fits for the vibrational and rotational constants of many states of nitrogen and oxygen
[AD-A229996] N91-21263
Numerical approximations of the Green's functions for a theoretical model of an aperture fed stacked-patch microstrip antenna
[AD-A230702] N91-21429
Identification of parameters derived from inertial sensors
[INPE-5166-RPE/637] N91-21746
Numerical recovery of certain discontinuous electrical conductivities
[NASA-CR-187543] N91-21800
Uncertainty estimates for derivatives and intercepts
[DE91-004503] N91-21802
Optimal Hankel-norm approximation and rational function models using impulse response data
[AD-A231317] N91-21839
LEGENDRE FUNCTIONS
A perturbation solution of the main problem in artificial satellite theory
[AD-A231560] N91-21227
LEGUMINOUS PLANTS
Evaluation of TM/LANDSAT-5 bands in the discrimination of wheat and beam crops
[INPE-5204-PRE/1666] N91-21602
TM/LANDSAT-5 multispectral reflectance for the remote sensing of the condition of bean crop vigor
[INPE-5184-PRE/1652] N91-21604
Spectral characteristics of agricultural crops and yield
[INPE-5125-RPE/630] N91-21619
LENS DESIGN
Reluctant glass formers and their applications in optical lens design N91-21351
LENSES
Modified chemical vapor deposition of gradient index lenses
[AD-A230989] N91-21281
Reluctant glass formers and their applications in optical lens design N91-21351
Holographic lens for wide field-of-view laser communication receiver
[AD-A231620] N91-21502
Transverse flow gas lens
[AD-A231366] N91-21878
LEVITATION
Large gap magnetic suspension system N91-21201
Stability considerations for magnetic suspension systems using electromagnets mounted in a planar array N91-21202
Containerless processing projects N91-21336
Thermophysical property measurements in electromagnetic levitators N91-21344
Surface tension and viscosity from damped free oscillations of viscous droplets N91-21346
Experiments for electromagnetic levitation in microgravity N91-21348
TEMPUS: First results N91-21350
High-temperature metal purification using a compact, portable rf heating and levitation system on the wake shield N91-21363
High temperature metal purification using a compact portable rf heating and levitation system on the wake shield N91-21365
Optical property measurements as a diagnostic tool for control of materials processing in space and on Earth N91-21366
High temperature acoustic and hybrid microwave/acoustic levitators for materials processing N91-21368
A new, simple electrostatic-acoustic hybrid levitator N91-21369
A high temperature thermal diffusivity determination procedure for solids and liquids N91-21377
LEVITATION MELTING
NASA-sponsored containerless processing experiments N91-21335
Compact rf heating and levitation systems for the NASA modular electromagnetic levitator N91-21364
Optical property measurements as a diagnostic tool for control of materials processing in space and on Earth N91-21366
Containerless processing of amorphous ceramics N91-21367
LIBRARIES
An automatic parallelization tool for sequential programs
[AD-A229972] N91-21771
LIFE (DURABILITY)
Analysis of rolling contact spall life in 440 C steel bearing rims
[NASA-CR-184101] N91-21526
LIFE SCIENCES
Exploring the living universe: A strategy for space life sciences
[NASA-TM-103399] N91-21696
Experiment Document Information System (EDIS) evolution N91-21941
Life sciences on-line: A study in hypermedia application N91-21943
LIFT
Lift and rolling moment due to spoilers on wings at subsonic speeds
[ESDU-90030] N91-21129
LIFTING BODIES
A finite-difference, frequency-domain numerical scheme for the solution of the linearized unsteady Euler equations N91-21067

Bifurcation analysis of the longitudinal dynamics of a simple powered lifting hypersonic vehicle
[AD-A230826] N91-21118

LIGHT EMITTING DIODES
Description of the Large-Gap Magnetic Suspension System (LGMSS) ground based experiment N91-21200
Fiber optic sensing system
[NASA-CASE-LEW-14795-1] N91-21871

LIGHT SCATTERING
Optical scattering methods applicable to drops and bubbles N91-21358
Stochastic and deterministic fluctuations in stimulated Brillouin scattering
[AD-A230988] N91-21522
Laser diagnostics for plasma turbulence
[DE91-009377] N91-21899

LIMITERS (FUSION REACTORS)
Comparison of beryllium and graphite first-walls in JET
[DE91-005489] N91-21884
High density regimes and beta limits in JET
[DE91-005490] N91-21885

LIMNOLOGY
Remote sensing estimation of total chlorophyll pigment distribution in Barra Bonita Reservoir
[INPE-5202-PRE/1664] N91-21603

LINE OF SIGHT
Probability estimates of cloud-obscured line-of-sight
[AD-A231151] N91-21678

LINE SPECTRA
Double 4f-collapse in Ce(0.9-x)Yb(x)Th(0.1)
[DE91-619752] N91-21908
Large-scale (CII) 158 micron emission of the Galaxy observed by a balloon-borne telescope N91-22004
Investigation of highly excited CO transitions in OMC-1 N91-22013
A highly collimated bipolar outflow in the core of OMC-1: CO submillimeter emission N91-22014
LDR: A submillimeter great observatory N91-22018
First detection of C3H2 at sub-mm wavelengths N91-22022
Submillimeter water masers at 321 and 325 GHz N91-22023
The 0 deg (63 micron) line emission from galactic high latitude cirrus clouds N91-22029

LINEAR ACCELERATORS
Design overview of a highly stable infrared free electron laser at LBL
[DE91-009327] N91-21508
Advanced, time-resolved imaging techniques for electron-beam characterizations
[DE91-008587] N91-21865

LINEAR ARRAYS
Analysis of 200 Hz CW tone propagation signal recorded during the September 1987 VLA experiment
[AD-A231053] N91-21414
High resolution beamforming on large aperture vertical line arrays: Processing synthetic data
[AD-A231054] N91-21415
A 200 Hz matched field processing on the September 1987 VLA data set
[AD-A231096] N91-21692

LINEAR EQUATIONS
Second-order discrete Kalman filtering equations for control-structure interaction simulations
[CU-CSSC-91-5] N91-21731
The IBM RISC System/6000 and linear algebra operations
[DE91-009221] N91-21805
Optimal Hankel-norm approximation and rational function models using impulse response data
[AD-A231317] N91-21839

LINEAR FILTERS
Implementation in two classes of C (++) for morphological processing of images
[INPE-5217-RPE/642] N91-21744

LINEAR PROGRAMMING
Stacking-sequence optimization for buckling of laminated plates by integer programming
[NASA-TM-104033] N91-21580
A monotone decreasing algorithm for the 0-1 multiknapsack dual problem
[INPE-5160-RPE/635] N91-21745
Interior-point methods for convex programming
[AD-A231372] N91-21765
Continuation and bifurcation investigations in constrained optimization
[AD-A231639] N91-21769

LINEAR QUADRATIC REGULATOR
Microgravity vibration isolation: An optimal control law for the one-dimensional case N91-21206
Closed-form solutions for linear regulator design of mechanical systems including optimal weighting matrix selection
[NASA-TM-104052] N91-21572
A linear quadratic regulator weight selection algorithm for robust pole assignment
[AD-A230598] N91-21737

LINEAR SYSTEMS
Deterministic and stochastic sensitivity in computational structural mechanics
[ISSN-0208-5658] N91-21571
Identification of linear multivariable systems from a single set of data by identification of observers with assigned real eigenvalues
[NASA-TM-102669] N91-21575

LINEARIZATION
Nonlinear compensation techniques for magnetic suspension systems N91-21204
Numerical recovery of certain discontinuous electrical conductivities
[NASA-CR-187543] N91-21800

LININGS
The effects of chemical protective gloves and glove liners on manual dexterity
[AD-A231250] N91-21721

LIPSCHITZ CONDITION
Interior-point methods for convex programming
[AD-A231372] N91-21765

LIQUEFIED GASES
Use of natural gas and liquefied petroleum gas in heavy-duty engines
[DE91-752990] N91-21546

LIQUID METALS
A dynamic technique for measuring surface tension at high temperatures in microgravity environment N91-21347

LIQUID NITROGEN
Evaluation of bearing configurations using the single bearing tester in liquid nitrogen
[NASA-TM-103527] N91-21532

LIQUID PHASES
Tractable high performance polymers
[AD-A231072] N91-21320

LIQUID PROPELLANT ROCKET ENGINES
Large liquid rocket engine transient performance simulation system
[NASA-CR-184099] N91-21232
Boundary layer study
[AD-A231343] N91-21482

LIQUID ROCKET PROPELLANTS
Elastomer compatibility with liquid propellant at elevated temperature
[AD-A230973] N91-21327

LIQUID SURFACES
Frictional and retarding forces on aircraft tyres. Part 5: Estimation of fluid drag forces
[ESDU-90035] N91-21537

LIQUID-SOLID INTERFACES
Radiographic instrumentation for DPM experiments N91-21373

LIQUIDS
NCTM of liquids at high temperatures using polarization techniques N91-21345
A high temperature thermal diffusivity determination procedure for solids and liquids N91-21377
Dip coating of sol-gels
[DE91-007571] N91-21872

LISTS
Source header list. Volume 1: A through K
[AD-A231000] N91-21971
Source header list. Volume 2: L through Z
[AD-A231001] N91-21972

LITHIUM ALLOYS
The mechanical property data base from an Air Force/industry cooperative test program on advanced aluminum alloys (8090 extrusion)
[AD-A230903] N91-21299

LITHIUM ISOTOPES
Colorado School of Mines fusion gamma ray diagnostic project
[DE91-009259] N91-21889

LITHOLOGY
Report of the panel on plate motion and deformation, section 2 N91-21591
Spot 1: Imagery in geologic mapping: A comparative study with several remote sensing products in the Curaca River Valley, Bahia
[INPE-5136-PRE/1624] N91-21608
Discrimination of lithological units in the lower Valley of the Curaca River (Bahia), through enhancement of digital processing of MSS-LANDSAT-3 data
[INPE-5120-RPE/627] N91-21613

LITHOSPHERE
Solid earth science in the 1990s. Volume 2: Panel reports
[NASA-TM-4256-VOL-2] N91-21590
Report of the panel on lithospheric structure and evolution, section 3 N91-21592

LOAD TESTING MACHINES
Evaluation of bearing configurations using the single bearing tester in liquid nitrogen
[NASA-TM-103527] N91-21532
Fully articulated four-point-bend loading fixture
[NASA-CASE-LEW-14776-1] N91-21540

LOAD TESTS
Stress wave propagation in hybrid composite materials N91-21249
Comparison of the post-buckling behavior of metallic and composite plates with centrally located cu touts
[PB91-118844] N91-21563
Mode 1 interlaminar fracture toughness of carbon/PEEK participation in an international round robin program
[FFA-TN-1990-41] N91-21570

LOADS (FORCES)
Reduction in bearing size due to superconductors in magnetic bearings N91-21211
Thermomechanics tasks and applications
[DLR-MITT-90-14] N91-21254
Single element magnetic suspension actuator
[NASA-CASE-LAR-13981-1] N91-21539
Tribological performance and deformation of sputter-deposited MoS2 solid lubricant films during sliding wear and indentation contact
[AD-A231003] N91-21547
On-orbit damage detection and health monitoring of large space trusses: Status and critical issues
[NASA-TM-104045] N91-21579

LOCAL AREA NETWORKS
Documentation for the token ring network simulation system
[NASA-CR-188093] N91-21789
Analysis of exhaustive limited service for token ring networks
[NASA-CR-188092] N91-21790
Queueing models for token and slotted ring networks
[NASA-CR-188091] N91-21791

LOGIC CIRCUITS
Silicon hybrid Wafer Scale Integration (WSI) used to fabricate a Hilbert transform integrated circuit module
[AD-A230605] N91-21428
Test generation for digital circuits using parallel processing
[AD-A231006] N91-21440
Proceedings of the Second Joint Technology Workshop on Neural Networks and Fuzzy Logic, volume 1
[NASA-CP-10061-VOL-1] N91-21778
Using fuzzy logic to integrate neural networks and knowledge-based systems N91-21788
Optical switching and optical logic in a thermally expanding Si etalon
[AD-A230706] N91-21870
Design and construction of a formed pulse circuit for a plasma centrifuge
[INPE-5161-RPE/639] N91-21895

LOGIC DESIGN
A demonstration of CMOS VLSI circuit prototyping in support of the site facility using the 1.2 micron standard cell library developed by National Security Agency
[NASA-CR-188014] N91-21426

LOGIC PROGRAMMING
SEPEC conference proceedings: Hypermedia and Information Reconstruction. Aerospace applications and research directions. Addendum
[NASA-CR-187936] N91-21955
AiGERM: A logic programming front end for GERM N91-21957

LONG WAVE RADIATION
Proof of the feasibility of coherent and incoherent schemes for pumping a gamma ray laser
[AD-A230897] N91-21520

LOW GRAVITY MANUFACTURING
Zeolites in space N91-21165
Containerless processing of amorphous ceramics N91-21367

LOW NOISE
Development of a low noise 10 KJ-T refrigeration system
[AD-A231383] N91-21392
Development of a low noise 10K J-T refrigeration system
[AD-A231461] N91-21393

LOW PASS FILTERS
Phase-lock-loop application for fiber optic receiver
[NASA-TM-102776] N91-21435

LOW PRESSURE
Heats of explosion at low pressures, 2
[AD-A231020] N91-21328

LOW REYNOLDS NUMBER
Experimental study of boundary layer transition on a heated flat plate
[NASA-TM-103779] N91-21061
Wind tunnel test of a propeller working in a low Reynolds number range
[NAL-TR-1071] N91-21112

LOW TEMPERATURE
Flexible diaphragm-extreme temperature usage
[NASA-CASE-MSC-20797-2] N91-21494
LUMINOSITY
A discussion of the xenon laser intensity as a function of pump rate
[DE91-009225] N91-21506
LUNAR ATMOSPHERE
Parametric entry corridors for lunar/Mars aerocapture missions
[NASA-TM-102178] N91-21168

M

MACH NUMBER
Computer program for the calculation of normal force and pitching moment of forebody-cylinder combinations at angles of attack up to 90 degrees and Mach numbers up to 5, including effects of conical boat-tailing
[ESDU-90034] N91-21102
MACH-ZEHNDER INTERFEROMETERS
Performance characteristics of Mach-Zehnder modulators for transfer of detector signals by optical fibers
[DE91-008439] N91-21873
MACHINING
Engineering specification and system design for CAD/CAM of custom shoes: UMC project effort
[NASA-CR-188049] N91-21733
MAGELLANIC CLOUDS
The Swedish-ESO Submillimeter Telescope (SEST) N91-22008
MAGNET COILS
Large gap magnetic suspension system N91-21201
Stability considerations for magnetic suspension systems using electromagnets mounted in a planar array N91-21202
MAGNETIC ANOMALIES
Comparative study of VLF signals in the sub-Antarctic region
[INPE-5165-TDL/426] N91-21406
Variability of the Sq focus position in the South American continent
[INPE-4740-PRE/1415] N91-21652
MAGNETIC BEARINGS
Magnetic bearings with zero bias N91-21194
Magnetic bearings for a spaceflight optical disk recorder N91-21195
Aerospace Applications of Magnetic Suspension Technology, part 2
[NASA-CP-10066-PT-2] N91-21203
A time delay controller for magnetic bearings N91-21205
Measurement and calculation of forces in a magnetic journal bearing actuator N91-21207
Critical speeds and forced response solutions for active magnetic bearing turbomachinery, part 1 N91-21209
Critical speeds and forced response solutions for active magnetic bearing turbomachinery, part 2 N91-21210
Reduction in bearing size due to superconductors in magnetic bearings N91-21211
MAGNETIC COILS
Considerations and studies for the construction of acceleration coils for inductive launchers
[ISL-CO-240/89] N91-21173
Spectral analysis of the heliotron field with the toroidal harmonic function in a study of the structure of built-in divertor
[NIFS-71] N91-21892
MAGNETIC FIELD CONFIGURATIONS
Spectral analysis of the heliotron field with the toroidal harmonic function in a study of the structure of built-in divertor
[NIFS-71] N91-21892
Kinetic stability of field-reversed configurations
[DE91-009530] N91-21901
Data analysis for the Pioneer-Venus electric field detector
[NASA-CR-188099] N91-22056
MAGNETIC FIELDS
A study of helium. Argon: Ethane gas mixtures used in drift chambers for large acceptance spectrometers in high magnetic fields
[AD-A231209] N91-21284
Transverse klystron
[AD-A231586] N91-21444
Report of the panel on lithospheric structure and evolution, section 3 N91-21592
Report of the panel on geopotential fields: Gravity field, section 8 N91-21597
Report of the panel on geopotential fields: Magnetic field, section 9 N91-21598
Geomagnetic model investigations for 1980 - 1989: A model for strategic defense initiative particle beam experiments and a study in the effects of data types and observatory bias solutions
[NASA-TM-104541] N91-21654
The physiological effects of 50/60 Hz electromagnetic fields: Standards and guidelines
[DE91-752996] N91-21705
On the temperature corrections for QED operators in the superstrong magnetic field
[DE91-619627] N91-21822
High density regimes and beta limits in JET
[DE91-005490] N91-21885
ICRF heating in reactor grade plasmas
[DE91-005491] N91-21886
The streamlined Darwin field method (and a solution technique that makes it practical)
[DE91-009482] N91-21903
The series Bi2Sr2Ca(n-1) Cu(n)O(2n+4) (1 less than or equal to n less than or equal to 5): Phase stability and superconducting properties
[NASA-TM-103749] N91-21910
Magnetic field induced broadening of the resistive transition in epitaxial films of YBa2Cu3O7 and Y2Ba4Cu8O16
[DE91-009825] N91-21916
The stucture of molecular clouds: New questions N91-22011
Solar-geophysical data number 553, September 1990. Part 1: (Prompt reports). Data for August 1990, July 1990, and late data
[PB91-113019] N91-22059
MAGNETIC PERMEABILITY
Spatial variations in ac susceptibility and microstructure for the YBa2Cu3O(7-x) superconductor and their correlation with room-temperature ultrasonic measurements
[NASA-TM-103787] N91-21553
MAGNETIC PROPERTIES
Chemical spray pyrolysis of Tl-Ba-Ca-Cu-O high-T(sub c) superconductors for high-field bitter magnets N91-21212
Magnetic quasicrystals
[AD-A231264] N91-21924
MAGNETIC STORMS
The effects of magnetic storm phases on F-layer irregularities from auroral to equatorial latitudes
[AD-A231373] N91-21658
MAGNETIC SUSPENSION
Aerospace Applications of Magnetic Suspension Technology, part 1
[NASA-CP-10066-PT-1] N91-21188
Magnetic suspension systems for space applications N91-21189
Advanced magnetic suspensions for vibration isolation and fast-attitude control of space-based generic pointing mounts N91-21190
A superconducting large-angle magnetic suspension N91-21191
Sliding mode control of magnetic suspensions for precision pointing and tracking applications N91-21193
Five degree-of-freedom control of an ultra-precision magnetically-suspended linear bearing N91-21196
Magnetic suspension and balance system advanced study, 1989 design N91-21197
Propulsion simulator for magnetically-suspended wind tunnel models N91-21198
A solid-state controllable power supply for a magnetic suspension wind tunnel N91-21199
Description of the Large-Gap Magnetic Suspension System (LGMSS) ground based experiment N91-21200
Large gap magnetic suspension system N91-21201
Stability considerations for magnetic suspension systems using electromagnets mounted in a planar array N91-21202
Aerospace Applications of Magnetic Suspension Technology, part 2
[NASA-CP-10066-PT-2] N91-21203
Nonlinear compensation techniques for magnetic suspension systems N91-21204
Dynamic modelling and analysis of a magnetically suspended flexible rotor N91-21208
Single element magnetic suspension actuator
[NASA-CASE-LAR-13981-1] N91-21539
Permanent magnet flux-biased magnetic actuator with flux feedback
[NASA-CASE-LAR-13785-1] N91-21824
MAGNETIC VARIATIONS
Comparative study of VLF signals in the sub-Antarctic region
[INPE-5165-TDL/426] N91-21406
MAGNETO-OPTICS
Magnetic bearings for a spaceflight optical disk recorder N91-21195
MAGNETOHYDRODYNAMIC FLOW
Observation of parallel viscosity in the CHS heliotron/torsatron
[NIFS-70] N91-21891
MAGNETOHYDRODYNAMIC STABILITY
Quasilinear simulation of auroral kilometric radiation by a relativistic Fokker-Planck code
[DE91-009736] N91-21656
Sawteeth and their stabilization in JET
[DE91-005459] N91-21882
Effect of electric field inhomogeneities on drift wave instabilities and anomalous transport
[NIFS-72] N91-21893
Some observations concerning alpha instabilities and driven tokamak reactors
[DE91-008628] N91-21898
Kinetic stability of field-reversed configurations
[DE91-009530] N91-21901
MAGNETORESISTIVITY
Chemical spray pyrolysis of Tl-Ba-Ca-Cu-O high-T(sub c) superconductors for high-field bitter magnets N91-21212
MAGNETOSTATICS
Experimental investigation of scattering of magnetostatic waves by surface acoustic waves
[DE91-009435] N91-21835
MAGSAT SATELLITES
Geomagnetic model investigations for 1980 - 1989: A model for strategic defense initiative particle beam experiments and a study in the effects of data types and observatory bias solutions
[NASA-TM-104541] N91-21654
MAINTENANCE
High-pressure promoted combustion chamber
[NASA-CASE-MSC-21470-1] N91-21157
Aerobrake assembly with minimum Space Station accommodation
[NASA-TM-102778] N91-21183
MAMMALS
Spiral vane bioreactor
[NASA-CASE-MSC-21361-1] N91-21701
MAN ENVIRONMENT INTERACTIONS
Bibliography on the international network of biosphere reserves
[PB90-215518] N91-21600
MAN MACHINE SYSTEMS
Computer animation of NASTRAN displacements on IRIS 4D-series workstations: CANDI/ANIMATE postprocessing of NASHUA results
[DE91-008605] N91-21585
National plan for aviation human factors, volume 1
[PB91-100339] N91-21712
National plan for aviation human factors, volume 2
[PB91-100347] N91-21713
MAN-COMPUTER INTERFACE
Graphical user interfaces in computational chemistry
[DE91-009116] N91-21267
A toolkit for designing user interfaces
[AD-A231558] N91-21723
SEPEC conference proceedings: Hypermedia and Infromation Reconstruction. Aerospace applications and research directions
[NASA-CR-187935] N91-21940
Engineering software development with HyperCard N91-21942
Life sciences on-line: A study in hypermedia application N91-21943
Hypermedia and intelligent tutoring applications in a mission operations environment N91-21948
GERM as a tool for space station documentation N91-21950
Automating hypertext for decision support N91-21951
Hypermedia as medium N91-21952
Hypermedia = hypercommunication N91-21953
SEPEC conference proceedings: Hypermedia and Information Reconstruction. Aerospace applications and research directions. Addendum
[NASA-CR-187936] N91-21955
MANAGEMENT INFORMATION SYSTEMS
Software development standards for project cost management information system
[AD-A231282] N91-21762
Identification of information needs in a research institute
[INPE-5154-TDL/425] N91-21967
MANAGEMENT METHODS
Issues in providing a reliable multicast facility
[NASA-CR-188089] N91-21403
Top quality management, reliability, and maintainability: Institutional goals with built in barriers
[AD-A230134] N91-21552
Administrative information systems plan, FY 1991 - FY 1995
[DE91-008072] N91-21964

MANAGEMENT SYSTEMS
Scan-line methods in spatial data systems
[AD-A231165] N91-21973
MANGANIN (TRADEMARK)
Stress-strain gage measurements on a Nevada Test Site (NTS) event using pairs of triple foil gages
[DE91-005061] N91-21497
MANIPULATORS
Control of free-flying space robot manipulator systems
[NASA-CR-188026] N91-21527
Experiments in cooperative-arm object manipulation with a two-armed free-flying robot
[NASA-CR-188028] N91-21529
Method and apparatus for configuration control of redundant robots
[NASA-CASE-NPO-17801-1-CU] N91-21544
MANNED MARS MISSIONS
Estimates of thermochemical relaxation lengths behind normal shock waves relevant to manned lunar and Mars return missions, the aeroassist flight experiment, and Mars entry
[NASA-TM-102879] N91-21471
MANUAL CONTROL
The effects of chemical protective gloves and glove liners on manual dexterity
[AD-A231250] N91-21721
MANUALS
A guide to ground vehicle operations on the airport
[AD-A231077] N91-21158
MANY BODY PROBLEM
Can non-Gaussian fluctuations for structure formation arise from inflation
[DE91-009458] N91-21655
Integrable Hamiltonian system in 2N dimensions
[DE91-619585] N91-21798
MAPPING
The use of a scanning electrochemicl impedance spectroscopy technique to investigate localized corrosion
[DE91-006918] N91-21296
Submillimeter observations with the Kuiper Airborne Observatory N91-21987
Early results from the Cosmic Background Explorer (COBE) N91-21988
The (C II) 158 micron line mapping of spiral galaxies N91-21996
MAPS
Stabilities of regular motion in the relativistic standard map
[NIFS-73] N91-21894
MARINE ENVIRONMENTS
On the response of the special sensor microwave/imager to the marine environment: Implications for atmospheric parameter retrievals
[NASA-CR-188032] N91-21684
The oceanic cloudy atmosphere: Measurement requirements and solution options
[AD-A231121] N91-21677
MARINE METEOROLOGY
Satellite-derived moisture-bogusing profiles for the Northwest Pacific Ocean
[AD-A231058] N91-21690
MARINE PROPULSION
Performance of small thrusters and propulsion systems
[AD-A231482] N91-21241
MARINE TECHNOLOGY
Tactical Environmental Support System (TESS(3)) satellite cloud analyses
[AD-A231247] N91-21681
MARKOV PROCESSES
Recent developments in Monte Carlo techniques
[DE91-009750] N91-21808
MARS (PLANET)
Analysis of periodic orbits about the Martian moons by continuation techniques
[AD-A231026] N91-22058
MARS ATMOSPHERE
Parametric entry corridors for lunar/Mars aerocapture missions
[NASA-TM-102178] N91-21168
Entry vehicle performance analysis and atmospheric guidance algorithm for precision landing on Mars
[AD-A231585] N91-21228
Cooling of in-situ propellant rocket engines for Mars mission
[NASA-TM-103729] N91-21233
Estimates of thermochemical relaxation lengths behind normal shock waves relevant to manned lunar and Mars return missions, the aeroassist flight experiment, and Mars entry
[NASA-TM-102879] N91-21471
MARS ENVIRONMENT
Entry vehicle performance analysis and atmospheric guidance algorithm for precision landing on Mars
[AD-A231585] N91-21228
MARS LANDING
Entry vehicle performance analysis and atmospheric guidance algorithm for precision landing on Mars
[AD-A231585] N91-21228
Cooling of in-situ propellant rocket engines for Mars mission
[NASA-TM-103729] N91-21233
MASKS
A compatibility assessment of the protective integrated hood mask with ANVIS night vision goggles
[AD-A229956] N91-21716
A field evaluation of the compatibility of the protective integrated hood mask with ANVIS night vision goggles
[AD-A230237] N91-21718
MASS BALANCE
Effects of gear box vibration and mass imbalance on the dynamics of multi-stage gear transmissions
[NASA-TM-103695] N91-21534
MASS FLOW RATE
Experimental and theoretical studies of vertical annular liquid jets
[DE91-008042] N91-21461
MASS SPECTROMETERS
Construction of flowing afterglow apparatus
[AD-A231062] N91-21855
MASS SPECTROSCOPY
Applications and current limitations of matrix-assisted laser desorption Fourier transform mass spectrometry for biomolecules
[DE91-008877] N91-21265
Rapid determination of drugs and semivolatile organics by direct thermal desorption ion trap mass spectrometry
[DE91-008885] N91-21278
MASS TRANSFER
Center for low-gravity fluid mechanics and transport phenomena
[NASA-CR-188048] N91-21452
MASSIVELY PARALLEL PROCESSORS
CFD simulation on a massively parallel processor N91-21387
Performance effects of irregular communications patterns on massively parallel multiprocessors
[NASA-CR-187514] N91-21724
Structural analysis on massively parallel computers
[DE91-009038] N91-21773
On the massively parallel solution of the assignment problem
[AD-A230847] N91-21775
MATCHING
Transitive, anti-symmetric relational attributes in structural description matching with applications to radar target identification
[AD-A231318] N91-21417
Feature matching for object localization in the presence of uncertainty
[AD-A231405] N91-21766
An efficient correspondence based algorithm for 2D and 3D model based recognition
[AD-A231406] N91-21767
MATERIALS SCIENCE
FWP executive summaries: Basic energy sciences, materials sciences programs
[DE91-009223] N91-21826
MATHEMATICAL LOGIC
Implementation of a matrix theorem prover for propositional modal logic
[INPE-5124-RPE/629] N91-21743
MATHEMATICAL MODELS
Simulation of turbomachinery flows N91-21069
Choice of velocity variables for complex flow computation N91-21076
Wave models for turbulent free shear flows N91-21086
Dynamics of local grid manipulations for internal flow problems N91-21090
Deep overheating of thin bodies in flight with very low-angled trajectory
[ISL-R-126/89] N91-21107
Flight path reconstruction using extended Kalman filtering techniques
[DLR-FB-90-41] N91-21108
Vortex bursting over a unit area aspect ratio delta wing using vortex paneling methods
[AD-A231028] N91-21119
Prediction of unsteady transonic separated flow for missile applications
[AD-A231259] N91-21120
A simple, analytical, axisymmetric microburst model for downdraft estimation
[NASA-TM-104053] N91-21132
Fully automatic guidance and control for rotorcraft nap-of-the-Earth flight following planned profiles. Volume 2: Mathematical model
[NASA-CR-177571-VOL-2] N91-21150
Description and evaluation of an interference assessment for a slotted-wall wind tunnel
[NASA-CR-4352] N91-21155
Rotary-balance testing for aircraft dynamics
[AGARD-AR-265] N91-21156
Control issues of microgravity vibration isolation N91-21192
Stability considerations for magnetic suspension systems using electromagnets mounted in a planar array N91-21202
Critical speeds and forced response solutions for active magnetic bearing turbomachinery, part 1 N91-21209
Critical speeds and forced response solutions for active magnetic bearing turbomachinery, part 2 N91-21210
Model correlation and damage location for large space truss structures: Secant method development and evaluation
[NASA-CR-188102] N91-21213
AEOSS design guide for system analysis on Advanced Earth-Orbital Spacecraft Systems
[NASA-TM-100772] N91-21223
AEOSS runtime manual for system analysis on Advanced Earth-Orbital Spacecraft Systems
[NASA-TM-100773] N91-21224
Improved fits for the vibrational and rotational constants of many states of nitrogen and oxygen
[AD-A229996] N91-21263
On the dynamics of the combustion process of hydrogen-air and hydrogen-methane-air mixtures
[ESA-TT-1198] N91-21268
Fast quasi-explicit finite difference simulation of electrochemical responses initiated by a discontinuous perturbation
[DE91-006917] N91-21271
Effect of equations of state on transient burning analysis of pyrotechnic materials in a closed system
[DE91-009167] N91-21280
The nucleation and growth of polycrystalline silicon carbide
[DE91-008887] N91-21304
Comparative study of VLF signals in the sub-Antarctic region
[INPE-5165-TDL/426] N91-21406
Transitive, anti-symmetric relational attributes in structural description matching with applications to radar target identification
[AD-A231318] N91-21417
Numerical approximations of the Green's functions for a theoretical model of an aperture fed stacked-patch microstrip antenna
[AD-A230702] N91-21429
Study of asymmetrical electric discharges using particle simulation
[INPE-5198-TDL/427] N91-21432
GEOSIM: A numerical model for geophysical fluid flow simulation
[NASA-TM-103528] N91-21450
A simple model vortex flow past a slender elliptic cone at incidence
[RAE-TM-AERO-2197] N91-21460
General three-dimensional disturbances to inviscid Couette flow
[DE91-009593] N91-21474
A criterion for the optimal design of multi-axis force sensors
[AD-A231014] N91-21500
Modeling the absorption of intense, short laser pulses in steep density gradients
[DE91-008735] N91-21503
Effects of gear box vibration and mass imbalance on the dynamics of multi-stage gear transmissions
[NASA-TM-103695] N91-21534
Large deformation behavior of long shallow cylindrical composite panels
[NASA-CR-4355] N91-21557
Update of PRONTO 2D and PRONTO 3D transient solid dynamics program
[DE91-009183] N91-21564
Comparison of several system identification methods for flexible structures
[NASA-TM-104046] N91-21574
PALM2D: A nonlinear finite element program for the coupled thermomechanical response of solids in two dimensions
[DE91-008423] N91-21584
Production of image proportions through a linear mixing model
[INPE-5170-PRE/1639] N91-21615
Volcanic effects on climate N91-21646
Geodynamics branch data base for main magnetic field analysis
[NASA-TM-104542] N91-21653

Geomagnetic model investigations for 1980 - 1989: A model for strategic defense initiative particle beam experiments and a study in the effects of data types and observatory bias solutions
[NASA-TM-104541] N91-21654
Probability estimates of cloud-obscured line-of-sight
[AD-A231151] N91-21678
Data assimilation and wind-stress error correction in a forced tropical ocean model N91-21687
A 200 Hz matched field processing on the September 1987 VLA data set
[AD-A231096] N91-21692
Objective use of satellite altimetry and IR in simulations of western boundary current dynamics
[AD-A231628] N91-21695
An empirical evaluation of analytical models for parallel relational database queries
[AD-A230813] N91-21752
Excision techniques in direct sequence spread spectrum communication systems
[AD-A231290] N91-21763
Queueing models for token and slotted ring networks
[NASA-CR-188091] N91-21791
Using artificial intelligence to aid in the development of causal models
[AD-A231273] N91-21794
A fully Galerkin method for the recovery of stiffness and damping parameters in Euler-Bernoulli beam models
[NASA-CR-187517] N91-21796
Numerical analysis and computation of nonlinear partial differential equations from applied mathematics
[AD-A231188] N91-21806
Recent developments in Monte Carlo techniques
[DE91-009750] N91-21808
Optimal Hankel-norm approximation and rational function models using impulse response data
[AD-A231317] N91-21839
Corrections to the participant-spectator model of high-energy alpha-particle fragmentation
[NASA-TM-4262] N91-21860
Some observations concerning alpha instabilities and driven tokamak reactors
[DE91-008628] N91-21898
National Geophysical Data Center: Programs and services (25th anniversary 1965-1990)
[PB91-123356] N91-21960
An introduction to financial and economic analysis: Power projects in industrializing and non-industrialized countries
[DE91-752995] N91-21976

MATHEMATICAL PROGRAMMING
Interior-point methods for convex programming
[AD-A231372] N91-21765

MATRICES (MATHEMATICS)
Closed-form solutions for linear regulator design of mechanical systems including optimal weighting matrix selection
[NASA-TM-104052] N91-21572
A linear quadratic regulator weight selection algorithm for robust pole assignment
[AD-A230598] N91-21737
Implementation of a matrix theorem prover for propositional modal logic
[INPE-5124-RPE/629] N91-21743
The IBM RISC System/6000 and linear algebra operations
[DE91-009221] N91-21805
Electron distortion effects in quasi-elastic electron scattering
[DE91-009034] N91-21843

MATRIX MATERIALS
Mechanical behavior of fiber reinforced SiC/RBSN ceramic matrix composites: Theory and experiment
[NASA-TM-103688] N91-21243
Synthesis of imide/arylene ether copolymers for adhesives and composite matrices
[NASA-TM-104067] N91-21306

MATRIX METHODS
Critical speeds and forced response solutions for active magnetic bearing turbomachinery, part 2 N91-21210

MAXIMUM ENTROPY METHOD
Spectral analysis of annual sunspot series: An update
[INPE-5207-PRE/1669] N91-22060

MAXIMUM LIKELIHOOD ESTIMATES
Temporal variation of areas occupied by aquatic macrophytes in the Tucurui reservoir through Landsat/TM data
[INPE-5174-PRE/1643] N91-21607
Iterative procedures for exact maximum likelihood estimation in the first-order Gaussian moving average model
[AD-A230812] N91-21809

MEASURE AND INTEGRATION
Asymptotic integration algorithms for nonhomogeneous, nonlinear, first order, ordinary differential equations
[NASA-TM-103793] N91-21797

MEASURING INSTRUMENTS
Description of the Large-Gap Magnetic Suspension System (LGMSS) ground based experiment N91-21200
Electro optical system to measure strains at high temperature
[NASA-CR-188148] N91-21492
Tank gauging apparatus and method
[NASA-CASE-MSC-21059-3] N91-21495
Preliminary field demonstration of a fiber-optic TCE sensor
[DE91-008453] N91-21498
Measurement capabilities of the Sandia, Livermore, Standards Laboratories
[DE91-008124] N91-21825

MECHANICAL DEVICES
Orbital debris sweeper and method
[NASA-CASE-MSC-21534-1] N91-21222
Alignment positioning mechanism
[NASA-CASE-MSC-21502-1] N91-21543
Passive dynamic controllers for nonlinear mechanical systems
[NASA-TM-104047] N91-21573

MECHANICAL DRIVES
Development of a low noise 10K J-T refrigeration system
[AD-A231461] N91-21393
Advanced rotorcraft transmission program
[NASA-TM-103276] N91-21531
Studies of a direct drive robot with a parallel configuration
[AD-A231265] N91-21548

MECHANICAL ENGINEERING
Superconducting Super Collider silicon tracking subsystem research and development
[DE91-009227] N91-21862

MECHANICAL PROPERTIES
Transverse cracking in a fiber reinforced ceramic matrix composite
[AD-A231029] N91-21259
Micromechanisms of friction in electrogalvanized sheet steel with emphasis on the role of texture
[DE91-009113] N91-21290
Synthesis of imide/arylene ether copolymers for adhesives and composite matrices
[NASA-TM-104067] N91-21306
Imide/arylene ether block copolymers
[NASA-TM-104066] N91-21308
An evaluation of the effects of varying composition and processing on several encapsulating resins
[DE91-009101] N91-21314
Tractable high performance polymers
[AD-A231072] N91-21320
Nondestructive imaging of materials microstructure using x ray tomographic microscopy
[DE91-008505] N91-21554
Closed-form solutions for linear regulator design of mechanical systems including optimal weighting matrix selection
[NASA-TM-104052] N91-21572
PALM2D: A nonlinear finite element program for the coupled thermomechanical response of solids in two dimensions
[DE91-008423] N91-21584
Superplastic creep of eutectic tin-lead solder joints
[DE91-009074] N91-21586

MELAMINE
Organic aerogels: A new type of ultrastructured polymer
[DE91-008500] N91-21312

MELTING
A dynamic technique for measuring surface tension at high temperatures in microgravity environment N91-21347
High-temperature metal purification using a compact, portable rf heating and levitation system on the wake shield N91-21363
The series Bi2Sr2Ca(n-1) Cu(n)O(2n+4) (1 less than or equal to n less than or equal to 5): Phase stability and superconducting properties
[NASA-TM-103749] N91-21910

MELTING POINTS
Containerless processing of amorphous ceramics N91-21367

MELTS (CRYSTAL GROWTH)
Experiments for electromagnetic levitation in microgravity N91-21348
Center for low-gravity fluid mechanics and transport phenomena
[NASA-CR-188048] N91-21452

MEMORY
From knowledge presentation to knowledge representation to knowledge construction: Future directions for hypermedia N91-21954

MEMORY (COMPUTERS)
Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics: Prospects of Computational Fluid Dynamics and Super Computers in Aerospace Science and Technology
[NAL-SP-13] N91-21379
Parallelization techniques for a supercomputer with hierarchical memory architecture N91-21386
The software system on parallel processor for computational fluid dynamics N91-21388
Fuzzy associative memories N91-21779

MENTAL PERFORMANCE
The development of perceptual/motor and cognitive performance measures under a high-G environment: A preliminary study
[AD-A231289] N91-21709

MERCURY CADMIUM TELLURIDES
Research in optical sciences
[AD-A230964] N91-21875

MESOMETEOROLOGY
Stratus surge prediction along the Central California coast
[PB91-129239] N91-21668

MESONS
Theory of photon and electron induced reactions
[DE91-008993] N91-21842

MESOSCALE PHENOMENA
Stratus surge prediction along the Central California coast
[PB91-129239] N91-21668
Satellite altimetry for naval oceancgraphy
[AD-A231081] N91-21691

MESSAGE PROCESSING
Very high speed holographic message routing for parallel machines
[AD-A230965] N91-21499

MESSAGES
Very high speed holographic message routing for parallel machines
[AD-A230965] N91-21499

METAL CRYSTALS
Study of relativistic electrons at channeling in a beryllium thick crystals
[DE91-619859] N91-21909

METAL FATIGUE
Analysis of rolling contact spall life in 440 C steel bearing rims
[NASA-CR-184101] N91-21526

METAL IONS
Broad-beam, high current, metal ion implantation facility
[DE91-009329] N91-21291
XANES (X ray Absorption Near Edge Structure) investigation of cerium as an inhibitor for Al alloys
[DE91-005542] N91-21293
The production and destruction of negative ions
[DE91-009517] N91-21850
Double 4f-collapse in Ce(0.9-x)Yb(x)Th(0.1)
[DE91-619752] N91-21908
Nonlinear optical spectroscopy of Ce3(+) ions in insulating crystals
[DE91-008928] N91-21913
Host materials for 4d(sup N) and 5d(sup N) transition-metal ions
[AD-A231606] N91-21933

METAL MATRIX COMPOSITES
Environmentally-induced passivity of aluminum alloys and aluminum metal matrix composites
[AD-A231350] N91-21301
HITCAN for actively cooled hot-composite thermostructural analysis
[NASA-TM-103750] N91-21562
Superconducting Super Collider silicon tracking subsystem research and development
[DE91-009227] N91-21862

METAL OXIDE SEMICONDUCTORS
Modeling failure and reliability in new-generation devices
[AD-A230998] N91-21439
Subthreshold I-V characteristics of AlGaAs/GaAs MODFETs: The role of unintentional acceptors
[AD-A230110] N91-21904

METAL PLATES
Comparison of the post-buckling behavior of metallic and composite plates with centrally located cu touts
[PB91-118844] N91-21563

METAL POWDER
Controlling fundamentals in high-energy high-rate pulsed power materials processing of powdered tungsten, titanium aluminides, and copper-graphite composites
[AD-A230900] N91-21298

METAL SHEETS
Micromechanisms of friction in electrogalvanized sheet steel with emphasis on the role of texture
[DE91-009113] N91-21290

METAL SURFACES
First principles theory of the interaction of hydrogen with surfaces and bulk of transition metals
[AD-A231248] N91-21285
Environmentally-induced passivity of aluminum alloys and aluminum metal matrix composites
[AD-A231350] N91-21301
Effective cleaning of oil-protected bearing steel examined by XPS analysis. Part 1: Cleaning by solvents and alkaline cleaners
[NAL-TR-1074] N91-21538
METAL VAPOR LASERS
The theory of temporal compression of intense pulses in a metal vapor
[DE91-005059] N91-21509
METAL VAPORS
Broad-beam, high current, metal ion implantation facility
[DE91-009329] N91-21291
The theory of temporal compression of intense pulses in a metal vapor
[DE91-005059] N91-21509
Laser pulse compression in strontium and calcium vapor
[DE91-007346] N91-21511
METAL WORKING
Toward high brightness, multi-kilowatt solid state lasers
[DE91-008990] N91-21504
METASTABLE STATE
Theoretical investigation of energy storage in atomic and molecular systems: Metastable molecular fuels
[AD-A230854] N91-21852
METEOROID HAZARDS
The micrometeoroid impact hazard in space: Techniques for damage simulation by pulsed lasers and environmental modelling N91-21220
METEOROLOGICAL CHARTS
Statistical forecasting of precipitation associated with the passage of frontal systems in the south region of Brazil
[INPE-5208-TDL/429] N91-21672
North Atlantic weather regimes: A synoptic study of phase space
[NASA-CR-188162] N91-21673
METEOROLOGICAL PARAMETERS
Atmospheric environment for space shuttle (STS-38) launch
[NASA-TM-103530] N91-21633
Case study analysis of clustering applied to VAS measurements
[PB91-127829] N91-21666
Intercomparison of the chemical and meteorological data generated from aircraft and shipboard sampling during GCE/CASE/WATOX
[PB91-129098] N91-21667
Statistical forecasting of precipitation associated with the passage of frontal systems in the south region of Brazil
[INPE-5208-TDL/429] N91-21672
Propagation of helicopter noise in the low atmosphere layers
[ISL-CO-203/90] N91-21830
METEOROLOGICAL RADAR
Gust front/wind shift detection algorithm for the terminal Doppler weather radar
[DOT/FAA/NR-91/4] N91-21671
METEOROLOGICAL RESEARCH AIRCRAFT
Intercomparison of the chemical and meteorological data generated from aircraft and shipboard sampling during GCE/CASE/WATOX
[PB91-129098] N91-21667
METEOROLOGICAL SATELLITES
Satellite cloud analyses: A nowcasting capability for the US Navy's TESS(3)
[AD-A231120] N91-21676
METEOROLOGY
The hemispheric eighth mesh terrain elevation and geography data sets
[AD-A231592] N91-21624
Environmental Research Laboratories publication abstracts, fiscal year 1990
[PB91-132035] N91-21627
Environment fact finding mission report
[PB91-130369] N91-21628
User's manual for SLAB: An atmospheric dispersion model for denser-than-air-releases
[DE91-008443] N91-21638
GEMPAK5 user's guide, version 5.0
[NASA-TM-4260] N91-21661
GEMPAK5. Part 1: GEMPAK5 programmer's guide, version 5.0
[NASA-TM-4261-PT-1] N91-21662
GEMPAK5. Part 2: GEMPLT programmer's guide, version 5.0
[NASA-TM-4261-PT-2] N91-21663
METHANE
On the dynamics of the combustion process of hydrogen-air and hydrogen-methane-air mixtures
[ESA-TT-1198] N91-21268
Hydrocarbon-fuel/combustion-chamber-liner materials compatibility
[NASA-CR-187104] N91-21307
Atmospheric methane data for the period 1986-1988 from the NOAA/CMDL global cooperative flask sampling network
[PB91-129122] N91-21626
METHOD OF MOMENTS
Numerical approximations of the Green's functions for a theoretical model of an aperture fed stacked-patch microstrip antenna
[AD-A230702] N91-21429
Analysis and design of antenna structures: Diakoptic theory and the moment method
[AD-A230838] N91-21438
METHYL ALCOHOL
High octane ethers from synthesis gas-derived alcohol
[DE91-008367] N91-21325
METHYL COMPOUNDS
Artifact diamond characterization
[AD-A231555] N91-21323
METROLOGY
The metrology of spherical shells using synchrotron x ray microtomography N91-21374
MICROBALLOONS
Time-resolved extreme-ultraviolet spectroscopy of laser-produced plasmas originating at the parylene layer of microballon targets
[DE91-009378] N91-21900
MICROBURSTS (METEOROLOGY)
A simple, analytical, axisymmetric microburst model for downdraft estimation
[NASA-TM-104053] N91-21132
MICROCOMPUTERS
Tropical cyclone track objective aids for the microcomputer: PCLM, XTRP, PCHP
[AD-A230851] N91-21675
MICROCRACKS
Physical property measurements on analog granites related to the joint verification experiment
[AD-A230571] N91-21650
MICROCRYSTALS
Formation of controlled adiabatic shear bands in AISI 4340 high strength steel
[AD-A230999] N91-21300
MICROELECTRONICS
How clean is clean. How clean is needed
[DE91-008173] N91-21391
The necessity for a DOD capability in superconducting electronics
[AD-A231553] N91-21931
MICROGRAVITY APPLICATIONS
Proceedings of the First Workshop on Containerless Experimentation in Microgravity
[NASA-CR-187806] N91-21331
Containerless experiments in fluid physics in microgravity N91-21341
NCTM of liquids at high temperatures using polarization techniques N91-21345
A dynamic technique for measuring surface tension at high temperatures in microgravity environment N91-21347
Experiments for electromagnetic levitation in microgravity N91-21348
TEMPUS: A facility for containerless electromagnetic processing onboard spacelab N91-21349
TEMPUS: First results N91-21350
Reluctant glass formers and their applications in optical lens design N91-21351
Containerless protein crystal growth technology: Electrostatic multidrop positioner N91-21352
A systematic investigation of the preparation and properties of composite carbon molecular sieves containing inorganic oxides N91-21353
Supercritical microgravity droplet vaporization N91-21354
Using a microgravity environment to probe wave turbulence N91-21355
Drop evaporation in a single-axis acoustic levitator N91-21356
Rheological properties, shape oscillations, and coalescence of liquid drops with surfactants N91-21357
Undercooling of acoustically levitated molten drops N91-21359
High-temperature metal purification using a compact, portable rf heating and levitation system on the wake shield N91-21363
High temperature metal purification using a compact portable rf heating and levitation system on the wake shield N91-21365
Containerless processing of amorphous ceramics N91-21367
Spiral vane bioreactor
[NASA-CASE-MSC-21361-1] N91-21701
MICROMECHANICS
Micromechanisms of friction in electrogalvanized sheet steel with emphasis on the role of texture
[DE91-009113] N91-21290
MICROMETEOROIDS
The micrometeoroid impact hazard in space: Techniques for damage simulation by pulsed lasers and environmental modelling N91-21220
MICROMINIATURIZATION
Development of a low noise 10K J-T refrigeration system
[AD-A231461] N91-21393
MICROORGANISMS
Comparison of the activity of subsurface and surface microorganisms and their anaerobic transformation of heterocyclic compounds
[DE91-008839] N91-21703
MICROPOROSITY
Organic aerogels: A new type of ultrastructured polymer
[DE91-008500] N91-21312
MICROSCOPES
Sample holder support for microscopes
[NASA-CASE-MFS-28420-1] N91-21545
MICROSCOPY
Nondestructive imaging of materials microstructure using x ray tomographic microscopy
[DE91-008505] N91-21554
MICROSTRIP ANTENNAS
L-band antenna array with integrated phase shifters
[ESA-TT-1215] N91-21405
Numerical approximations of the Green's functions for a theoretical model of an aperture fed stacked-patch microstrip antenna
[AD-A230702] N91-21429
MICROSTRUCTURE
The overall response of composite materials undergoing large elastic deformations
[AD-A231637] N91-21260
Controlling fundamentals in high-energy high-rate pulsed power materials processing of powdered tungsten, titanium aluminides, and copper-graphite composites
[AD-A230900] N91-21298
Formation of controlled adiabatic shear bands in AISI 4340 high strength steel
[AD-A230999] N91-21300
Experiments for electromagnetic levitation in microgravity N91-21348
Fundamental investigation of micelles and microemulsions in supercritical fluids
[AD-A231073] N91-21476
X ray laser holography of biological microstructures
[DE91-008732] N91-21488
Spatial variations in ac susceptibility and microstructure for the YBa2Cu3O(7-x) superconductor and their correlation with room-temperature ultrasonic measurements
[NASA-TM-103787] N91-21553
Nondestructive imaging of materials microstructure using x ray tomographic microscopy
[DE91-008505] N91-21554
Structural characterization of the Ag/YBa2Cu3O(7-x) interface
[DE91-009112] N91-21907
The effect of microstructure on the thermal conductivity of ZnS/diamond composites
[AD-A231349] N91-21928
MICROWAVE AMPLIFIERS
Estimating power amplifier large signal gain
[AD-A230823] N91-21437
MICROWAVE ANTENNAS
Extended database of microwave common carrier antenna gain patterns
[PB91-119206] N91-21398
MICROWAVE ATTENUATION
On the response of the special sensor microwave/imager to the marine environment: Implications for atmospheric parameter retrievals
[NASA-CR-188032] N91-21664
Laboratory evaluation and application of microwave absorption properties under simulated conditions for planetary atmospheres
[NASA-CR-188096] N91-22057
MICROWAVE EQUIPMENT
The oceanic cloudy atmosphere: Measurement requirements and solution options
[AD-A231121] N91-21677
MICROWAVE IMAGERY
On the response of the special sensor microwave/imager to the marine environment: Implications for atmospheric parameter retrievals
[NASA-CR-188032] N91-21664

Satellite cloud analyses: A nowcasting capability for the US Navy's TESS(3)
[AD-A231120] N91-21676

MICROWAVE RADIOMETERS
Calibration transfer target for a microwave radiometric profiling system
[PB91-129080] N91-21647
A search for episodic increases in upper atmospheric water vapor as evidence of an extraterrestrial source
[AD-A231598] N91-21660

MICROWAVE TRANSMISSION
Long-term performance and propagation measurements on single and tandem digital microwave transmission links. Volume 1: Analysis of measurement data
[PB91-129643] N91-21396
Long-term performance and propagation measurements on single and tandem digital microwave transmission links. Volume 2: Appendixes
[PB91-129650] N91-21397

MICROWAVES
GaAs monolithic RF modules for SARSAT distress beacons
[NASA-TM-104338] N91-21184
Containerless synthesis of ceramic materials using microwave heating N91-21360
High temperature acoustic and hybrid microwave/acoustic levitators for materials processing N91-21368
Long-term performance and propagation measurements on single and tandem digital microwave transmission links. Volume 1: Analysis of measurement data
[PB91-129643] N91-21396
Long-term performance and propagation measurements on single and tandem digital microwave transmission links. Volume 2: Appendixes
[PB91-129650] N91-21397
Estimating power amplifier large signal gain
[AD-A230823] N91-21437
Free electron lasers
[AD-A230817] N91-21519
The microwave background: Its smoothness and frequency distribution as an astrophysical product N91-21992
Laboratory evaluation and application of microwave absorption properties under simulated conditions for planetary atmospheres
[NASA-CR-188096] N91-22057

MIDAIR COLLISIONS
Model rocketry hazard study
[DOT/FAA/CT-TN90/28] N91-21238

MIGRATION
Grain boundaries
[DE91-007932] N91-21905

MILITARY OPERATIONS
Cloud classification of DMSP visible and IR imagery using physical and textural features
[AD-A231186] N91-21680
Satellite altimetry for naval oceanography
[AD-A231061] N91-21691
Noise effects upon a simple timing channel
[AD-A230818] N91-21726
An object oriented design and implementation of the IDEF(sub 0) essential model using Ada and an Ada based expert system
[AD-A230814] N91-21753
Interaction of strategic defenses with crisis stability
[DE91-009002] N91-21814
Discrimination options in the near term
[DE91-009000] N91-21818
Strategic defense system: Stable design and adequate testing must precede decision to deploy
[AD-A230864] N91-21820

MILITARY SPACECRAFT
Notes on space, satellites, and survivability
[DE91-009229] N91-21226

MILITARY TECHNOLOGY
An object-oriented military simulation baseline for parallel simulation research
[AD-A231030] N91-21755
First Annual Meeting of International Neural Network Society
[AD-A230283] N91-21777

MILKY WAY GALAXY
The confusion limits to the sensitivity of submillimeter telescopes N91-22001
Large-scale (CII) 158 micron emission of the Galaxy observed by a balloon-borne telescope N91-22004

MILLIMETER WAVES
Millimeter observations of a complete sample of galaxies: Implications for gas mass and cold dust component N91-21999
The 1.3 mm continuum emission from circumstellar envelopes N91-22007
The Swedish-ESO Submillimeter Telescope (SEST) N91-22008
New Cologne acousto-optical spectrometer projects N91-22034
Submillimetre observations of solar-system objects N91-22037
The mm and sub-mm wave planar antenna arrays for SIS detectors N91-22046
Laboratory evaluation and application of microwave absorption properties under simulated conditions for planetary atmospheres
[NASA-CR-188096] N91-22057
An unusual case of meter wave type-3 bursts leading millimeter-wave bursts
[INPE-5140-PRE/1628] N91-22064

MIMD (COMPUTERS)
CFD simulation on a massively parallel processor N91-21387

MINERAL DEPOSITS
A digital data bank for geological exploration in the mining belt of the Pojuca (Carajas) Cu-Zn deposit, based on geological, geochemical, remote sensing, and elevation data
[INPE-5172-PRE/1641] N91-21617

MINERAL EXPLORATION
Volcanic-sedimentary sequence of the Greenstone Belt type in the Santa Rita or Goias elevation: An approach with TM-Landsat data
[INPE-5178-PRE/1647] N91-21610

MINERALS
Third Information Transfer Meeting
[PB91-123922] N91-21961

MIRA VARIABLES
The 1.3 mm continuum emission from circumstellar envelopes N91-22007

MISALIGNMENT
Alignment positioning mechanism
[NASA-CASE-MSC-21502-1] N91-21543

MISSILE CONFIGURATIONS
Prediction of unsteady transonic separated flow for missile applications
[AD-A231259] N91-21120

MISSILE CONTROL
Specification of the autonomous missile guidance problem for the TA11 processor. Volume 4: Processor mini-spec
[FFI-90/4005-VOL-4] N91-21145
Specification of the autonomous missile guidance problem for the TA11 processor. Volume 6: Specification mode 16, N
[FFI-90/4005-VOL-6] N91-21146
Specification of the autonomous missile guidance problem for the TA11 processor. Volume 7: Specification mode 29, N + A + T + H
[FFI-90/4005-VOL-7] N91-21147
Specification of the autonomous missile guidance problem for the TA11 processor. Volume 8: Specification mode 30, N + A + T + B
[FFI-90/4005-VOL-8] N91-21148

MISSILE DETECTION
Background issues for defensive interceptors
[DE91-009219] N91-21819

MISSILE RANGES
Near-term boost-phase defense sensitivities
[DE91-008999] N91-21813
Effectiveness of bomber deployed autonomous airborne vehicles in finding rail mobile SS-24s
[DE91-009008] N91-21815

MISSILES
Advantage of nonguided hypervelocity projectiles in antimissile warfare
[ISL-R-110/90] N91-21174
Efficient approaches for report/cluster correlation in multitarget tracking systems
[AD-A231589] N91-21421
Effectiveness of bomber deployed autonomous airborne vehicles in finding rail mobile SS-24s
[DE91-009008] N91-21815

MISSION PLANNING
Parametric entry corridors for lunar/Mars aerocapture missions
[NASA-TM-102178] N91-21168

MIXING
Computation of turbulent high speed mixing layers using a two-equation turbulence model N91-21084
Basic rheology and its application to nitrocellulose propellant processing by screw mix-extruders
[AD-A230872] N91-21326
Production of image proportions through a linear mixing model
[INPE-5170-PRE/1639] N91-21615

MIXING CIRCUITS
Requirements for SIS receivers in the 500-1000 GHz region N91-22015

MIXING LAYERS (FLUIDS)
The direct simulation of high-speed mixing-layers without and with chemical heat release N91-21095

MODELS
Model rocketry hazard study
[DOT/FAA/CT-TN90/28] N91-21238
Transverse cracking in a fiber reinforced ceramic matrix composite
[AD-A231029] N91-21259
Tractable high performance polymers
[AD-A231072] N91-21320
Free electron lasers
[AD-A230817] N91-21519
An endorsement-based approach to student modeling for planner-controlled intelligent tutoring systems
[NASA-CR-188177] N91-21739
Computer aided design tools and algorithms for submicron technologies
[AD-A231171] N91-21757
A heterogeneous parallel programming capability
[AD-A229710] N91-21772
Subthreshold I-V characteristics of AlGaAs/GaAs MODFETs: The role of unintentional acceptors
[AD-A230110] N91-21904

MODFETS
Subthreshold I-V characteristics of AlGaAs/GaAs MODFETs: The role of unintentional acceptors
[AD-A230110] N91-21904

MODULATION
Enhanced selectivity and detectability in absorption and fluorescence methods based on polarization modulation
[DE91-008926] N91-21279
Performance characteristics of Mach-Zehnder modulators for transfer of detector signals by optical fibers
[DE91-008439] N91-21873

MODULATORS
GaAs monolithic RF modules for SARSAT distress beacons
[NASA-TM-104338] N91-21184
Performance characteristics of Mach-Zehnder modulators for transfer of detector signals by optical fibers
[DE91-008439] N91-21873

MODULUS OF ELASTICITY
Physical property measurements on analog granites related to the joint verification experiment
[AD-A230571] N91-21650

MOISTURE CONTENT
Wet atmospheric generation apparatus
[NASA-CASE-MFS-28177-1] N91-21496

MOLECULAR ABSORPTION
A systematic investigation of the preparation and properties of composite carbon molecular sieves containing inorganic oxides N91-21353

MOLECULAR BEAM EPITAXY
Molecular beam epitaxial growth and electronic properties of GaP-on-Si (211) heterostructures, and of related systems
[AD-A231125] N91-21921
Kinetic aspects of lattice mismatch in molecular beam epitaxial growth on planar and patterned substrates
[AD-A231636] N91-21934

MOLECULAR BIOLOGY
X ray laser holography of biological microstructures
[DE91-008732] N91-21488
A center for the study of early events in photosynthesis
[DE91-008509] N91-21698

MOLECULAR CLOUDS
The (C II) 158 micron line mapping of spiral galaxies N91-21996
The stucture of molecular clouds: New questions N91-22011
Submillimeter astronomy and low mass star formation N91-22012
Investigation of highly excited CO transitions in OMC-1 N91-22013
A highly collimated bipolar outflow in the core of OMC-1: CO submillimeter emission N91-22014
Interstellar chemistry and submillimetre astronomy N91-22021
The submillimeter wave astronomy satellite N91-22025
The search for protostars in high mass star forming regions N91-22030

MOLECULAR DIFFUSION
Observation of spectral diffusion in crystals using single impurity molecules
[AD-A231338] N91-21926

MOLECULAR ENERGY LEVELS
Theoretical investigation of energy storage in atomic and molecular systems: Metastable molecular fuels
[AD-A230854] N91-21852

MOLECULAR EXCITATION
Theoretical investigation of energy storage in atomic and molecular systems: Metastable molecular fuels
[AD-A230854] N91-21852

MOLECULAR FLOW
A highly collimated bipolar outflow in the core of OMC-1: CO submillimeter emission N91-22014
MOLECULAR RELAXATION
Estimates of thermochemical relaxation lengths behind normal shock waves relevant to manned lunar and Mars return missions, the aeroassist flight experiment, and Mars entry
[NASA-TM-102879] N91-21471
MOLECULAR STRUCTURE
Applications and current limitations of matrix-assisted laser desorption Fourier transform mass spectrometry for biomolecules
[DE91-008877] N91-21265
Contributions of conformational and structural defects to the hyper-polarizabilities of polymers
[DE91-009042] N91-21313
Strength of polymer interfaces
[AD-A230839] N91-21318
Tractable high performance polymers
[AD-A231072] N91-21320
MOLYBDENUM DISULFIDES
Tribological performance and deformation of sputter-deposited MoS2 solid lubricant films during sliding wear and indentation contact
[AD-A231003] N91-21547
MOMENTS
Stability analysis of time-dependent transport algorithms
[DE91-009170] N91-21750
Transport via moments of quantum distribution functions
[AD-A231182] N91-21821
MOMENTUM
Experimental study of boundary layer transition on a heated flat plate
[NASA-TM-103779] N91-21061
MOMENTUM THEORY
Choice of velocity variables for complex flow computation N91-21076
MOMENTUM TRANSFER
Transport in auxiliary-heated, hot-ion H-mode and L-mode discharges in the DIII-D tokamak
[DE91-008924] N91-21887
MONOCHROMATORS
Beam line and associated work
[AD-A231243] N91-21867
MONTE CARLO METHOD
Computer aided design tools and algorithms for submicron technologies
[AD-A231171] N91-21757
Uncertainty estimates for derivatives and intercepts
[DE91-004503] N91-21802
Recent developments in Monte Carlo techniques
[DE91-009750] N91-21808
MOON
Analysis of periodic orbits about the Martian moons by continuation techniques
[AD-A231026] N91-22058
MORPHOLOGY
Tribological performance and deformation of sputter-deposited MoS2 solid lubricant films during sliding wear and indentation contact
[AD-A231003] N91-21547
Report of the panel on plate motion and deformation, section 2 N91-21591
Verification of parameters and morphological-environmental properties, by satellite imagery, for studies of coastal region planning
[INPE-5177-PRE/1646] N91-21606
Implementation in two classes of C (++) for morphological processing of images
[INPE-5217-RPE/642] N91-21744
Structural characterization of the Ag/YBa2Cu3O(7-x) interface
[DE91-009112] N91-21907
MOTION SIMULATION
Generalizing the hop: Object-level programming for legged motion
[AD-A231315] N91-21549
A plane-sweep algorithm for exact simulation of a quasi-static mechanical system of compliantly-connected rigid bodies (extended abstract)
[AD-A231324] N91-21550
MOTION SIMULATORS
Suppression of biodynamic interference in head-tracked teleoperation
[NASA-TM-103833] N91-21134
MOTION STABILITY
Bifurcation analysis of the longitudinal dynamics of a simple powered lifting hypersonic vehicle
[AD-A230826] N91-21118
Stabilities of regular motion in the relativistic standard map
[NIFS-73] N91-21894
MOTOR VEHICLES
Effectiveness of bomber deployed autonomous airborne vehicles in finding rail mobile SS-24s
[DE91-009008] N91-21815
MOUNTING
Advanced magnetic suspensions for vibration isolation and fast-attitude control of space-based generic pointing mounts N91-21190
Alignment positioning mechanism
[NASA-CASE-MSC-21502-1] N91-21543
MULTIBEAM ANTENNAS
SAW technology for multicarrier demodulation in advanced payloads N91-21164
MULTIPHOTON ABSORPTION
High brightness electron beam production by laser induced various order multiphoton photoeffects of gold
[DE91-009150] N91-21514
Nonlinear optical spectroscopy of Ce3(+) ions in insulating crystals
[DE91-008928] N91-21913
MULTIPLEXING
Physiology data acquisition system description
[AD-A231088] N91-21706
MULTIPROCESSING (COMPUTERS)
Parallelization techniques for a supercomputer with hierarchical memory architecture N91-21386
An empirical study of combining communicating processes in a parallel discrete event simulation
[AD-A230982] N91-21412
Performance effects of irregular communications patterns on massively parallel multiprocessors
[NASA-CR-187514] N91-21724
Structural analysis on massively parallel computers
[DE91-009038] N91-21773
MULTISENSOR APPLICATIONS
Multiple sensor multifrequency eddy current monitor for solidification and growth N91-21362
MULTISPECTRAL BAND SCANNERS
Spot 1: Imagery in geologic mapping: A comparative study with several remote sensing products in the Curaca River Valley, Bahia
[INPE-5136-PRE/1624] N91-21608
MULTISPECTRAL PHOTOGRAPHY
Data integration of different sensor systems through the technique of IHS transformation, the purpose and study of intra-urban structure
[INPE-5171-PRE/1640] N91-21616
MULTISTATIC RADAR
Analysis and testing of a bistatic radar cross section measurement capability for the AFIT anechoic chamber
[AD-A230609] N91-21401
Application of the finite element method to random rough surface scattering with Neumann boundary conditions
[AD-A231583] N91-21420
MUTATIONS
Specificity of mutation induced by ionizing radiation and oxidizing free radicals
[DE91-008838] N91-21702

N

NAP-OF-THE-EARTH NAVIGATION
Simulation of nap-of-the-Earth flight in helicopters
[NASA-TM-102830] N91-21131
Fully automatic guidance and control for rotorcraft nap-of-the-Earth flight following planned profiles. Volume 1: Real-time piloted simulation
[NASA-CR-177571-VOL-1] N91-21149
Fully automatic guidance and control for rotorcraft nap-of-the-Earth flight following planned profiles. Volume 2: Mathematical model
[NASA-CR-177571-VOL-2] N91-21150
NAPHTHENES
Flow visualization ion helicopter blades using Acenaphthen
[DLR-FB-90-37] N91-21466
NASA PROGRAMS
Space station: NASA's search for design, cost, and schedule stability continues
[GAO/NSIAD-91-125] N91-21187
Exploring the living universe: A strategy for space life sciences
[NASA-TM-103399] N91-21696
NASA authorizations
[S-HRG-101-981] N91-21977
NASA overview N91-21978
Mission to Planet Earth N91-21980
Aeronautics and space technology N91-21981
Space science and applications N91-21982
The 1991/92 graduate student researchers program, including the underrepresented minority focus component
[NASA-TM-101801] N91-22065
NASTRAN
Computer animation of NASTRAN displacements on IRIS 4D-series workstations: CANDI/ANIMATE postprocessing of NASHUA results
[DE91-008605] N91-21585
NATIONAL AEROSPACE PLANE PROGRAM
Recent update of the RPLUS2D/3D codes N91-21094
NATURAL GAS
Laser probes of natural gas ignition chemistry
[PB91-127993] N91-21262
Development of a gas engine-driven chiller
[PB91-130237] N91-21389
Use of natural gas and liquefied petroleum gas in heavy-duty engines
[DE91-752990] N91-21546
NATURAL LANGUAGE (COMPUTERS)
IDEAL, a dialogic interface in a natural language for expert systems
[INPE-5151-TDL/424] N91-21742
NATURAL SATELLITES
Submillimetre observations of solar-system objects N91-22037
A search for stellar occultations by Uranus, Neptune, Pluto, and their satellites: 1990-1999
[NASA-CR-188146] N91-22053
NAVIER-STOKES EQUATION
Computational study of three dimensional viscous flow through a turbine cascade using a multi-domain spectral technique N91-21066
A pressure flux-split technique for computation of inlet flow behavior N91-21068
Numerical solutions of 2-D multi-stage rotor/stator unsteady flow interactions N91-21070
Transonic cascade flow calculations using non-periodic C-type grids N91-21071
Computation of supersonic and low subsonic cascade flows using an explicit Navier-Stokes technique and the kappa-epsilon turbulence model N91-21072
Flux-vector splitting for the 1990s N91-21073
Choice of velocity variables for complex flow computation N91-21076
Distributed Minimal Residual (DMR) method for acceleration of iterative algorithms N91-21077
A pressure based method for the solution of viscous incompressible turbomachinery flows N91-21078
Implicit solution of three-dimensional internal turbulent flows N91-21082
Numerical investigation of an internal layer in turbulent flow over a curved hill N91-21083
Solution of three-dimensional afterbody flow using reduced Navier-Stokes equations N91-21093
Numerical simulation of transverse fuel injection N91-21097
On the nonlinear stability of a high-speed, axisymmetric boundary layer
[NASA-CR-187538] N91-21099
Blunt trailing edge analysis of supercritical airfoils by a Navier-Stokes code
[NAL-TR-1075-T] N91-21114
On the mapping properties of boundary integral operators for Navier-Stokes like equations
[FFA-TN-1989-41] N91-21467
Existence and uniqueness results for problems arising in connection with the incompressible Navier-Stokes equations
[FFA-TN-1989-43] N91-21468
NAVIGATION
AVHRR/NOAA imagery navigation from the geodetic reference matrix: Studies and evaluations
[INPE-5216-PRE/1672] N91-21126
A model for addressing navigation limitations and metacognitive constraints in hypermedia training systems N91-21945
NAVIGATION AIDS
A 200 Hz matched field processing on the September 1987 VLA data set
[AD-A231096] N91-21692
NAVIGATION SATELLITES
System and method for measuring ocean surface currents at locations remote from land masses using synthetic aperture radar
[NASA-CASE-NPO-17937-1-CU] N91-21621
NAVY
Embedded computers: Navy's approach to developing patrol aircraft avionics system too risky
[AD-A230868] N91-21136
Satellite altimetry for naval oceanography
[AD-A231081] N91-21691
NEAR INFRARED RADIATION
Discrimination of lithological units in the lower Valley of the Curaca River (Bahia), through enhancement of digital processing of MSS-LANDSAT-3 data
[INPE-5120-RPE/627] N91-21613

NEGATIVE IONS
Review of negative hydrogen ion sources
[DE91-009461] N91-21848
The production and destruction of negative ions
[DE91-009517] N91-21850
NEODYMIUM LASERS
Surface cleaning by laser ablation
[DE91-009189] N91-21505
NEPHANALYSIS
The hemispheric eighth mesh terrain elevation and geography data sets
[AD-A231592] N91-21624
NEPTUNE (PLANET)
A search for stellar occultations by Uranus, Neptune, Pluto, and their satellites: 1990-1999
[NASA-CR-188146] N91-22053
NETWORK ANALYSIS
First Annual Meeting of International Neural Network Society
[AD-A230283] N91-21777
Analysis of exhaustive limited service for token ring networks
[NASA-CR-188092] N91-21790
NEUMANN PROBLEM
Application of the finite element method to random rough surface scattering with Neumann boundary conditions
[AD-A231583] N91-21420
On the slowness of phase boundary motion in one space dimension
[AD-A231286] N91-21480
NEURAL NETS
Speech recognition using Kohonen neural networks, dynamic programming, and multi-feature fusion
[AD-A230951] N91-21410
Applications of artificial neural nets in structural mechanics
[NASA-TM-102420] N91-21559
Computing with neural networks: A comparison of the multi-layer perceptron and the hierarchical pattern recognition network for classification problems
[AD-A231584] N91-21768
First Annual Meeting of International Neural Network Society
[AD-A230283] N91-21777
Proceedings of the Second Joint Technology Workshop on Neural Networks and Fuzzy Logic, volume 1
[NASA-CP-10061-VOL-1] N91-21778
Neural network representation and learning of mappings and their derivatives N91-21780
Radar signal categorization using a neural network N91-21782
Learning control of inverted pendulum system by neural network driven fuzzy reasoning: The learning function of NN-driven fuzzy reasoning under changes of reasoning environment N91-21785
Solution of inverse problem of fuzzy relational equation by using perceptron model N91-21786
Experiments on neural network architectures for fuzzy logic N91-21787
Using fuzzy logic to integrate neural networks and knowledge-based systems N91-21788
NEUROLOGY
First Annual Meeting of International Neural Network Society
[AD-A230283] N91-21777
NEUTRAL ATOMS
Application of Fourier-Fresnel imaging to neutral-atom interferometry
[AD-A231154] N91-21857
NEUTRAL BEAMS
Observation of parallel viscosity in the CHS heliotron/torsatron
[NIFS-70] N91-21891
NEWTON METHODS
Rapidly convergent algorithms for nonsmooth optimization
[AD-A231110] N91-21756
NICKEL ALLOYS
An evaluation of GTAW-P versus GTA welding of alloy 718
[NASA-TM-103529] N91-21287
NIGHT VISION
A compatibility assessment of the protective integrated hood mask with ANVIS night vision goggles
[AD-A229956] N91-21716
A field evaluation of the compatibility of the protective integrated hood mask with ANVIS night vision goggles
[AD-A230237] N91-21718
NIKE ROCKETS
Kauai Test Facility two experiment rocket campaign
[DE91-008894] N91-21172
NIOBIUM
Compact rf heating and levitation systems for the NASA modular electromagnetic levitator N91-21364
Dependence of the photorefractive properties of KTa(1-x)Nb(x)O3:Cu,V on Cu valence state concentration
[AD-A230954] N91-21917
NITRIC OXIDE
Nonintrusive nitric oxide density measurements in the NASA Langley arc-heated scramjet engine test facility
[AD-A231260] N91-21142
NITROGEN
Improved fits for the vibrational and rotational constants of many states of nitrogen and oxygen
[AD-A229996] N91-21263
NITROGEN OXIDES
Adaptation of the Advanced Statistical Trajectory Regional Air Pollution (ASTRAP) model to the EPA VAX computer: Modifications and testing
[PB91-127720] N91-21631
NOAA 7 SATELLITE
AVHRR/NOAA imagery navigation from the geodetic reference matrix: Studies and evaluations
[INPE-5216-PRE/1672] N91-21126
NOISE (SOUND)
Calculation of thickness and charge noise radiated by a rotor in forward flight
[ISL-R-119/89] N91-21831
FY 1989 acoustics research
[AD-A231499] N91-21840
NOISE GENERATORS
A study of rotor broadband noise mechanisms and helicopter tail rotor noise
[NASA-CR-177565] N91-21829
NOISE INTENSITY
Case study analysis of clustering applied to VAS measurements
[PB91-127829] N91-21666
NOISE PREDICTION
Noise factor and antenna gains in the signal/noise equation for over-the-horizon radar
[AD-A231203] N91-21416
NOISE PREDICTION (AIRCRAFT)
Velocity measurements in a turbulent trailing vortex and their application to BWI noise prediction
[NASA-CR-188083] N91-21100
NOISE PROPAGATION
Blade-wake interaction on a two blade rotor with prediction of the radiated noise stationary and forward flight, comparison between calculation, and experiment
[ISL-R-120/89] N91-21832
NOISE REDUCTION
Advanced rotorcraft transmission program
[NASA-TM-103276] N91-21531
NOISE TEMPERATURE
AEDC focal plane array test capability
[AD-A230846] N91-21408
NONDESTRUCTIVE TESTS
Mechanical behavior of fiber reinforced SiC/RBSN ceramic matrix composites: Theory and experiment
[NASA-TM-103688] N91-21243
The use of a scanning electrochemicl impedance spectroscopy technique to investigate localized corrosion
[DE91-006918] N91-21296
The metrology of spherical shells using synchrotron x ray microtomography N91-21374
Heat-rate improvements obtained with the use of enhanced tubes in surface condensers
[DE91-006565] N91-21449
Spatial variations in ac susceptibility and microstructure for the YBa2Cu3O(7-x) superconductor and their correlation with room-temperature ultrasonic measurements
[NASA-TM-103787] N91-21553
NONEQUILIBRIUM FLOW
Recent update of the RPLUS2D/3D codes N91-21094
NONLINEAR EQUATIONS
A method for the geometrically nonlinear analysis of compressively loaded prismatic composite structures
[NASA-CR-184846] N91-21561
Asymptotic integration algorithms for nonhomogeneous, nonlinear, first order, ordinary differential equations
[NASA-TM-103793] N91-21797
Numerical analysis and computation of nonlinear partial differential equations from applied mathematics
[AD-A231188] N91-21806
NONLINEAR FEEDBACK
Bifurcation analysis of the longitudinal dynamics of a simple powered lifting hypersonic vehicle
[AD-A230826] N91-21118
Nonlinear compensation techniques for magnetic suspension systems N91-21204
Research in optical sciences
[AD-A230964] N91-21875
NONLINEAR OPTICS
Optical NIPI device characterization
[AD-A231157] N91-21922
NONLINEAR PROGRAMMING
Rapidly convergent algorithms for nonsmooth optimization
[AD-A231110] N91-21756
Continuation and bifurcation investigations in constrained optimization
[AD-A231639] N91-21769
NONLINEAR SYSTEMS
Nonlinear compensation techniques for magnetic suspension systems N91-21204
Research in nonlinear water waves
[AD-A231205] N91-21477
Research studies on extreme ultraviolet and soft x ray lasers
[AD-A231033] N91-21523
Passive dynamic controllers for nonlinear mechanical systems
[NASA-TM-104047] N91-21573
Adaptive output-feedback control of systems with output nonlinearities
[AD-A231249] N91-21793
Kinetic stability of field-reversed configurations
[DE91-009530] N91-21901
NONLINEARITY
On the nonlinear stability of a high-speed, axisymmetric boundary layer
[NASA-CR-187538] N91-21099
Sliding mode control of magnetic suspensions for precision pointing and tracking applications N91-21193
Research in nonlinear water waves
[AD-A231205] N91-21477
Application of the p-version FE method to geometrically non-linear problems in three dimensions
[FFA-TN-1990-33] N91-21589
Adaptive output-feedback control of systems with output nonlinearities
[AD-A231249] N91-21793
Asymptotic integration algorithms for nonhomogeneous, nonlinear, first order, ordinary differential equations
[NASA-TM-103793] N91-21797
NORWAY
From Earth to space and back: Selected papers on Norwegian space activities
[NSC-REPT(90)2] N91-21159
Development of Norwegian space activities N91-21160
Offshore technology R and D in space applications N91-21162
Space research in Norway N91-21167
NOSE CONES
Investigation of nose bluntness and angle of attack effects on slender bodies in viscous hypertension flows
[NASA-CR-188153] N91-21117
Shuttle Entry Air Data System (SEADS) hardware development. Volume 1: Summary
[NASA-CR-166044-VOL-1] N91-21179
Shuttle Entry Air Data System (SEADS) hardware development. Volume 2: History
[NASA-CR-166044-VOL-2] N91-21180
NOWCASTING
Satellite cloud analyses: A nowcasting capability for the US Navy's TESS(3)
[AD-A231120] N91-21676
NOZZLE FLOW
Hot gas ingestion test results of a two-poster vectored thrust concept with flow visualization in the NASA Lewis 9- x 15-foot low speed wind tunnel
[NASA-TM-103258] N91-21116
CFD for hypersonic propulsion
[NASA-TM-103791] N91-21447
Some treatments on boundary conditions for quasi one-dimensional Euler equations
[FFA-TN-1990-36] N91-21469
NOZZLE GEOMETRY
Static thrust-vectoring performance of nonaxisymmetric convergent-divergent nozzles with post-exit yaw vanes
[NASA-TP-3085] N91-21059
An experimental comparison of nonswirling and swirling flow in a circular-to-rectangular transition duct
[NASA-TM-104359] N91-21115
Experimental and theoretical studies of vertical annular liquid jets
[DE91-008042] N91-21461
Comparison of UNL laser imaging and sizing system and a phase Doppler system for analyzing sprays from a NASA nozzle
[NASA-CR-185239] N91-21485
NUCLEAR CAPTURE
Colorado School of Mines fusion gamma ray diagnostic project
[DE91-009259] N91-21889
NUCLEAR DEVICES
Recent JET results and future prospects
[DE91-005474] N91-21897

NUCLEAR EMULSIONS
Multi-core events in cosmic-ray induced interactions with lead at around 10 TeV
[DE91-616827] N91-22062
NUCLEAR EXPLOSION EFFECT
Background issues for defensive interceptors
[DE91-009219] N91-21819
NUCLEAR EXPLOSIONS
Stress-strain gage measurements on a Nevada Test Site (NTS) event using pairs of triple foil gages
[DE91-005061] N91-21497
NUCLEAR FUELS
High density regimes and beta limits in JET
[DE91-005490] N91-21885
NUCLEAR MAGNETIC RESONANCE
Artifact diamond characterization
[AD-A231555] N91-21323
NUCLEAR MODELS
Electron distortion effects in quasi-elastic electron scattering
[DE91-009034] N91-21843
NUCLEAR PHYSICS
Review of CERN heavy-ion physics
[DE91-009326] N91-21844
NUCLEAR PUMPING
Optical properties of a nuclear reactor pumped gas laser
[DE91-009226] N91-21507
NUCLEAR RADIATION
Radiation health research, 1986 - 1990
[NASA-TM-4270] N91-21704
Nuclear radiation detectors
[INPE-5090-MD/44] N91-21847
NUCLEAR REACTIONS
Electron distortion effects in quasi-elastic electron scattering
[DE91-009034] N91-21843
Review of CERN heavy-ion physics
[DE91-009326] N91-21844
Strange particles production and absorption in nuclei at high energies
[DE91-620399] N91-21845
Colorado School of Mines fusion gamma ray diagnostic project
[DE91-009259] N91-21889
Characteristic x rays method for detecting cold fusion
[DE91-619982] N91-21890
NUCLEAR REACTORS
Optical properties of a nuclear reactor pumped gas laser
[DE91-009226] N91-21507
Recent JET results and future prospects
[DE91-005474] N91-21897
NUCLEAR ROCKET ENGINES
Evaluation of transportation systems for advanced spaceflight missions
[DLR-FB-90-39] N91-21181
NUCLEAR STRUCTURE
Electron distortion effects in quasi-elastic electron scattering
[DE91-009034] N91-21843
NUCLEATION
The nucleation and growth of polycrystalline silicon carbide
[DE91-008887] N91-21304
Charge of the containerless experimentation in microgravity N91-21332
Containerless processing of undercooled melts N91-21339
Undercooling of acoustically levitated molten drops N91-21359
Nucleation and growth of diamond on Si, Cu and Au substrates
[AD-A231044] N91-21918
NUCLEONS
Review of CERN heavy-ion physics
[DE91-009326] N91-21844
NUMERICAL ANALYSIS
Numerical analysis methods. Volume 3: Autocorrection methods
[INPE-5196-MD/45] N91-21807
NUMERICAL CONTROL
Aerobic production of ethanol
[PB91-119172] N91-21324
Experiments in cooperative-arm object manipulation with a two-armed free-flying robot
[NASA-CR-188028] N91-21529
NUMERICAL INTEGRATION
Distributed Minimal Residual (DMR) method for acceleration of iterative algorithms N91-21077
NUMERICAL STABILITY
Stability analysis of time-dependent transport algorithms
[DE91-009170] N91-21750
NUMERICAL WEATHER FORECASTING
Satellite-derived moisture-bogusing profiles for the Northwest Pacific Ocean
[AD-A231058] N91-21690
NUTRIENTS
WINTER 1990 hydrographics data report: CTD station profiles, sections, nutrients, SAIL, January - February 1990
[DE91-008286] N91-21686

O

O RING SEALS
O-ring gasket test fixture
[NASA-CASE-MFS-28376-1] N91-21175
OBJECT PROGRAMS
Generalizing the hop: Object-level programming for legged motion
[AD-A231315] N91-21549
An object-oriented military simulation baseline for parallel simulation research
[AD-A231030] N91-21755
OBLIQUE SHOCK WAVES
Heat transfer, velocity-temperature correlation, and turbulent shear stress from Navier-Stokes computations of shock wave/turbulent boundary layer interaction flows N91-21085
OBSTACLE AVOIDANCE
Fully automatic guidance and control for rotorcraft nap-of-the-Earth flight following planned profiles. Volume 1: Real-time piloted simulation
[NASA-CR-177571-VOL-1] N91-21149
Method and apparatus for configuration control of redundant robots
[NASA-CASE-NPO-17801-1-CU] N91-21544
OCCULTATION
Redistribution of particulates on a payload during flight ascent
[NASA-TM-104539] N91-21255
OCCUPATION
The 1991/92 graduate student researchers program, including the underrepresented minority focus component
[NASA-TM-101801] N91-22065
OCCURRENCES
Comparative study of VLF signals in the sub-Antarctic region
[INPE-5165-TDL/426] N91-21406
OCEAN BOTTOM
High-frequency acoustic scattering
[AD-A230880] N91-21836
OCEAN CURRENTS
WINTER 1990 hydrographics data report: CTD station profiles, sections, nutrients, SAIL, January - February 1990
[DE91-008286] N91-21686
Dynamics of oceanic motions
[AD-A231135] N91-21693
Objective use of satellite altimetry and IR in simulations of western boundary current dynamics
[AD-A231628] N91-21695
OCEAN DATA ACQUISITIONS SYSTEMS
Satellite altimetry for naval oceanography
[AD-A231081] N91-21691
OCEAN DYNAMICS
Cloud and ocean effects on global greenhouse warming
[DE91-008842] N91-21639
Large eddy simulation: Where do we stand
[AD-A230835] N91-21657
OCEAN MODELS
Specification for a standard radar sea clutter model
[AD-A230848] N91-21409
Cloud and ocean effects on global greenhouse warming
[DE91-008842] N91-21639
Global monthly sea surface temperature climatology
[PB91-129304] N91-21669
Current velocity and hydrographic observations in the southwestern North Atlantic Ocean: Subtropical Atlantic Climate Studies (STACS), 1989
[PB91-115535] N91-21685
Data assimilation and wind-stress error correction in a forced tropical ocean model N91-21687
Statistical properties of the sea surface sound dipole source
[AD-A230811] N91-21688
OCEAN SURFACE
System and method for measuring ocean surface currents at locations remote from land masses using synthetic aperture radar
[NASA-CASE-NPO-17937-1-CU] N91-21621
On the response of the special sensor microwave/imager to the marine environment: Implications for atmospheric parameter retrievals
[NASA-CR-188032] N91-21664
Cloud classification of DMSP visible and IR imagery using physical and textural features
[AD-A231186] N91-21680
Statistical properties of the sea surface sound dipole source
[AD-A230811] N91-21688
Interaction of surface waves and near surface currents
[AD-A231612] N91-21694
OCEAN TEMPERATURE
WINTER 1990 hydrographics data report: CTD station profiles, sections, nutrients, SAIL, January - February 1990
[DE91-008286] N91-21686
OCEANOGRAPHY
Environmental Research Laboratories publication abstracts, fiscal year 1990
[PB91-132035] N91-21627
Large eddy simulation: Where do we stand
[AD-A230835] N91-21657
Tactical Environmental Support System (TESS(3)) satellite cloud analyses
[AD-A231247] N91-21681
Implementation of an oceanographic expert system: Problems, feedback, solutions
[AD-A230886] N91-21689
National Geophysical Data Center: Programs and services (25th anniversary 1965-1990)
[PB91-123356] N91-21960
OCEANS
The oceanic cloudy atmosphere: Measurement requirements and solution options
[AD-A231121] N91-21677
FY 1989 acoustics research
[AD-A231499] N91-21840
OFFSHORE PLATFORMS
Offshore technology R and D in space applications N91-21162
OGIVES
Comparison study of the aerodynamic coefficients measured on models with circular or squared section and large elongation in supersonic flow
[ISL-R-125/89] N91-21106
OILS
Drop coalescence studies N91-21375
OLIGOMERS
Synthesis of imide/arylene ether copolymers for adhesives and composite matrices
[NASA-TM-104067] N91-21306
ON-LINE SYSTEMS
Life sciences on-line: A study in hypermedia application N91-21943
ONBOARD EQUIPMENT
Methodology development for the verification and validation of flight critical systems software, phase 1
[AD-A229932] N91-21735
ONE DIMENSIONAL FLOW
Some treatments on boundary conditions for quasi one-dimensional Euler equations
[FFA-TN-1990-36] N91-21469
OPENINGS
Comparison of the post-buckling behavior of metallic and composite plates with centrally located cu touts
[PB91-118844] N91-21563
OPERATING SYSTEMS (COMPUTERS)
VM-CMS tutorial
[DE91-009444] N91-21725
VHSIC Hardware Description Language (VHDL) benchmark suite
[AD-A231276] N91-21761
OPERATOR PERFORMANCE
The development of perceptual/motor and cognitive performance measures under a high-G environment: A preliminary study
[AD-A231289] N91-21709
Human performance concerns for the TRACKWOLF system
[AD-A231359] N91-21722
OPERATORS (MATHEMATICS)
On the mapping properties of boundary integral operators for Navier-Stokes like equations
[FFA-TN-1989-41] N91-21467
On the temperature corrections for QED operators in the superstrong magnetic field
[DE91-619627] N91-21822
OPTICAL COMMUNICATION
Phase-lock-loop application for fiber optic receiver
[NASA-TM-102776] N91-21435
OPTICAL COMPUTERS
Digital optical computer global interconnect algorithm study
[AD-A230282] N91-21736

OPTICAL CORRECTION PROCEDURE
Radiatively-cooled telescopes for infrared space astronomy N91-22048
Telescope technology for space-borne submillimeter astronomy N91-22049
OPTICAL DATA PROCESSING
Serrated circular apertures: Optical Fourier transforms and fractal analysis
[AD-A230834] N91-21874
OPTICAL DISKS
Magnetic bearings for a spaceflight optical disk recorder N91-21195
OPTICAL EQUIPMENT
Reluctant glass formers and their applications in optical lens design N91-21351
Optical NIPI device characterization
[AD-A231157] N91-21922
OPTICAL FIBERS
Statistical fluctuations in lasers
[DE91-009540] N91-21517
Performance characteristics of Mach-Zehnder modulators for transfer of detector signals by optical fibers
[DE91-008439] N91-21873
OPTICAL HETERODYNING
Far-infrared heterodyne technology N91-22016
OPTICAL MATERIALS
The Japanese containerless experiments N91-21338
New materials and new techniques for imaging of long wavelength IR radiation
[AD-A231086] N91-21877
Optical NIPI device characterization
[AD-A231157] N91-21922
OPTICAL MEASUREMENT
The spacecraft control laboratory experiment optical attitude measurement system
[NASA-TM-102624] N91-21186
Description of the Large-Gap Magnetic Suspension System (LGMSS) ground based experiment N91-21200
NCTM of liquids at high temperatures using polarization techniques N91-21345
OPTICAL PROPERTIES
NCTM of liquids at high temperatures using polarization techniques N91-21345
Optical scattering methods applicable to drops and bubbles N91-21358
Optical property measurements as a diagnostic tool for control of materials processing in space and on Earth N91-21366
Optical properties of a nuclear reactor pumped gas laser
[DE91-009226] N91-21507
Theory of the electronic and optical properties of semiconductor heterostructures
[AD-A231438] N91-21929
OPTICAL PUMPING
A discussion of the xenon laser intensity as a function of pump rate
[DE91-009225] N91-21506
Amplification of femtosecond pulses using a N2 pump laser
[DE91-008413] N91-21513
OPTICAL RADAR
Estimations of ABL fluxes and other turbulence parameters from Doppler lidar data
[NASA-CR-188062] N91-21648
Estimations of ABL fluxes and other turbulence parameters from Doppler lidar data
[NASA-CR-188053] N91-21665
OPTICAL RESONATORS
High efficiency surface-emitting semiconductor laser resonators
[DE91-005236] N91-21510
OPTICAL SWITCHING
Optical switching and optical logic in a thermally expanding Si etalon
[AD-A230706] N91-21870
OPTICAL TRACKING
Suppression of biodynamic interference in head-tracked teleoperation
[NASA-TM-103833] N91-21134
The spacecraft control laboratory experiment optical attitude measurement system
[NASA-TM-102624] N91-21186
OPTICS
Application of Fourier-Fresnel imaging to neutral-atom interferometry
[AD-A231154] N91-21857
OPTIMAL CONTROL
Continuation and bifurcation investigations in constrained optimization
[AD-A231639] N91-21769
OPTIMIZATION
Application of SAW technology in satellites for mobile services N91-21163
A stochastic approach to the problem of spacecraft optimal manoeuvres
[INPE-5192-PRE/1660] N91-21171
Heat-rate improvements obtained with the use of enhanced tubes in surface condensers
[DE91-006565] N91-21449
A criterion for the optimal design of multi-axis force sensors
[AD-A231014] N91-21500
Applications of artificial neural nets in structural mechanics
[NASA-TM-102420] N91-21559
Structural analysis and optimization of a propfan blade by use of the finite element method
[ESA-TT-1216] N91-21566
Cloud classification of DMSP visible and IR imagery using physical and textural features
[AD-A231186] N91-21680
Rapidly convergent algorithms for nonsmooth optimization
[AD-A231110] N91-21756
Continuation and bifurcation investigations in constrained optimization
[AD-A231639] N91-21769
ORBIT CALCULATION
OD system for the first Brazilian satellite-software testing, analysis, and assessment
[INPE-5158-PRE/1637] N91-21169
Analysis of error in TOMS total ozone as a function of orbit and attitude parameters
[NASA-CR-4361] N91-21670
ORBITAL MECHANICS
Requirements and trade-off studies in satellite mechanical architecture
[INPE-5186-PRE/1654] N91-21219
Analysis of periodic orbits about the Martian moons by continuation techniques
[AD-A231026] N91-22058
ORBITS
Stabilities of regular motion in the relativistic standard map
[NIFS-73] N91-21894
ORDER-DISORDER TRANSFORMATIONS
Magnetic quasicrystals
[AD-A231264] N91-21924
ORGANIC CHEMISTRY
The organic chemistry of conducting polymers
[DE91-009520] N91-21316
ORGANIC COMPOUNDS
Analytical chemistry laboratory
[DE91-008986] N91-21266
Rapid determination of drugs and semivolatile organics by direct thermal desorption ion trap mass spectrometry
[DE91-008885] N91-21278
Preliminary field demonstration of a fiber-optic TCE sensor
[DE91-008453] N91-21498
Field intercomparison of precipitation samplers for assessing wet deposition of organic contaminants
[PB91-125880] N91-21629
ORGANIC SULFUR COMPOUNDS
The organic chemistry of conducting polymers
[DE91-009520] N91-21316
ORGANIZATIONS
Source header list. Volume 1: A through K
[AD-A231000] N91-21971
Source header list. Volume 2: L through Z
[AD-A231001] N91-21972
Unified agenda of Federal regulations, October 1990
[PB91-120527] N91-21984
ORIENTATION
Elastic response of zone axis (001)-oriented PWA 1480 single crystal: The influence of secondary orientation
[NASA-TM-103782] N91-21558
ORION NEBULA
Investigation of highly excited CO transitions in OMC-1 N91-22013
A highly collimated bipolar outflow in the core of OMC-1: CO submillimeter emission N91-22014
ORTHOTROPIC CYLINDERS
Large deformation behavior of long shallow cylindrical composite panels
[NASA-CR-4355] N91-21557
ORTHOTROPIC PLATES
Delamination and free edge stresses in laminated plates subjected to constant uniaxial strain (computer program)
[ESDU-90021] N91-21253
OSCILLATING FLOW
Graduate fellowship in hypersonics
[AD-A231263] N91-21478
OSCILLATIONS
Surface tension and viscosity from damped free oscillations of viscous droplets N91-21346
Oscillational instabilities in single mode acoustics levitators N91-21376
Predicting chaos for infinite dimensional dynamical systems: The Kuramoto-Sivashinsky equation, a case study
[NASA-CR-187531] N91-21454
Nonlinear symmetric instability and oscillations in the tropical atmosphere N91-21674
Diffusive transport enhancement by isolated resonances and distribution tails growth in hadronic beams
[DE91-006379] N91-21864
OSCILLATORS
Quartz crystal resonators and oscillators for frequency control and timing applications: A tutorial, revision 4
[AD-A231604] N91-21445
Toward high brightness, multi-kilowatt solid state lasers
[DE91-008990] N91-21504
OVER-THE-HORIZON RADAR
Noise factor and antenna gains in the signal/noise equation for over-the-horizon radar
[AD-A231203] N91-21416
OXIDASE
Electron transfer between glucose oxidase and electrodes via redox mediators bound with flexible chains to the enzyme surface
[AD-A231115] N91-21856
OXIDATION
Catalyst for carbon monoxide oxidation
[NASA-CASE-LAR-14155-2-SB] N91-21270
Scanning tunneling microscopy of reactive sites: Gasification of graphite by oxygen and hydrogen
[DE91-008569] N91-21274
Specificity of mutation induced by ionizing radiation and oxidizing free radicals
[DE91-008838] N91-21702
Dependence of the photorefractive properties of KTa(1-x)Nb(x)O3:Cu,V on Cu valence state concentration
[AD-A230954] N91-21917
An investigation of Si-SiO2 interface charges in thermally oxidated (100), (110), (111), (511) silicon
[AD-A231244] N91-21923
OXIDATION-REDUCTION REACTIONS
Aerobic production of ethanol
[PB91-119172] N91-21324
Electron transfer between glucose oxidase and electrodes via redox mediators bound with flexible chains to the enzyme surface
[AD-A231115] N91-21856
OXIDE FILMS
Ex-situ and in-situ ellipsometric studies of the thermal oxide on InP
[AD-A231095] N91-21283
Growth and characterization of thin films of Y2O3, La2O3 and La2CuO4
[AD-A231046] N91-21919
Preparation and characterization of Iron(III) oxide films by an novel spray pyrolysis method
[AD-A231047] N91-21920
OXIDES
A systematic investigation of the preparation and properties of composite carbon molecular sieves containing inorganic oxides N91-21353
OXIDIZERS
Evaluation of air injection in a sudden expansion diffuser for real-time afterburning application
[AD-A230850] N91-21141
OXYGEN
Cooling of in-situ propellant rocket engines for Mars mission
[NASA-TM-103729] N91-21233
Improved fits for the vibrational and rotational constants of many states of nitrogen and oxygen
[AD-A229996] N91-21263
Investigation of highly excited CO transitions in OMC-1 N91-22013
OXYGEN ATOMS
Atomic oxygen degradation of Intelsat 4-type solar array interconnects: Laboratory investigations
[NASA-TM-102175] N91-21286
OXYGEN CONSUMPTION
Interstellar chemistry and submillimetre astronomy N91-22021
OXYGEN-HYDROCARBON ROCKET ENGINES
Heavy hydrocarbon main injector technology program
[NASA-CR-188082] N91-21235
Hydrocarbon-fuel/combustion-chamber-liner materials compatibility
[NASA-CR-187104] N91-21307
OZONE
Analysis of error in TOMS total ozone as a function of orbit and attitude parameters
[NASA-CR-4361] N91-21670

P

PACKAGING
Pre-integrated structures for Space Station Freedom
[NASA-TM-102780] N91-21214
PACKET TRANSMISSION
Queueing models for token and slotted ring networks
[NASA-CR-188091] N91-21791
PACKETS (COMMUNICATION)
Issues in providing a reliable multicast facility
[NASA-CR-188089] N91-21403
PALLADIUM
Characteristic x rays method for detecting cold fusion
[DE91-619982] N91-21890
PANEL METHOD (FLUID DYNAMICS)
Vortex bursting over a unit area aspect ratio delta wing using vortex paneling methods
[AD-A231028] N91-21119
Description and evaluation of an interference assessment for a slotted-wall wind tunnel
[NASA-CR-4352] N91-21155
PANELS
Orbital debris sweeper and method
[NASA-CASE-MSC-21534-1] N91-21222
PARALLEL COMPUTERS
Digital optical computer global interconnect algorithm study
[AD-A230282] N91-21736
Computer aided design tools and algorithms for submicron technologies
[AD-A231171] N91-21757
PARALLEL FLOW
Transverse flow gas lens
[AD-A231366] N91-21878
PARALLEL PROCESSING (COMPUTERS)
Computer requirements for further CFD development N91-21380
CFD development present and prospects at NAL N91-21385
Parallelization techniques for a supercomputer with hierarchical memory architecture N91-21386
The software system on parallel processor for computational fluid dynamics N91-21388
An empirical study of combining communicating processes in a parallel discrete event simulation
[AD-A230982] N91-21412
Test generation for digital circuits using parallel processing
[AD-A231006] N91-21440
Very high speed holographic message routing for parallel machines
[AD-A230965] N91-21499
Performance effects of irregular communications patterns on massively parallel multiprocessors
[NASA-CR-187514] N91-21724
Analysis, preliminary design and simulation systems for control-structure interaction problems
[NASA-CR-188018] N91-21729
Implementation of a partitioned algorithm for simulation of large CSI problems
[CU-CSSC-91-4] N91-21730
Parallel computations and control of adaptive structures N91-21732
A modified SLIC material interface reconstruction algorithm for Eulerian codes
[DE91-009175] N91-21740
An object-oriented military simulation baseline for parallel simulation research
[AD-A231030] N91-21755
Fast algorithms for signal processing
[AD-A231226] N91-21759
Graphical representation of parallel algorithmic processes
[AD-A231258] N91-21760
Normalized convergence rates for the PSMG method
[AD-A231311] N91-21764
Structural analysis on massively parallel computers
[DE91-009038] N91-21773
On the massively parallel solution of the assignment problem
[AD-A230847] N91-21775
PARALLEL PROGRAMMING
Test generation for digital circuits using parallel processing
[AD-A231006] N91-21440
An automatic parallelization tool for sequential programs
[AD-A229972] N91-21771
A heterogeneous parallel programming capability
[AD-A229710] N91-21772
PARAMETER IDENTIFICATION
Identification of parameters derived from inertial sensors
[INPE-5166-RPE/637] N91-21746
PARAMETERIZATION
Transitive, anti-symmetric relational attributes in structural description matching with applications to radar target identification
[AD-A231318] N91-21417
On the response of the special sensor microwave/imager to the marine environment: Implications for atmospheric parameter retrievals
[NASA-CR-188032] N91-21664
Statistical properties of the sea surface sound dipole source
[AD-A230811] N91-21688
Continuation and bifurcation investigations in constrained optimization
[AD-A231639] N91-21769
PARTIAL DIFFERENTIAL EQUATIONS
On the anomaly of velocity-pressure decoupling in collocated mesh solutions
[NASA-TM-103769] N91-21448
Layer tracking asymptotics and domain decomposition
[DE91-008593] N91-21462
Functional specifications for mathematical computations
[DE91-006002] N91-21803
Numerical analysis and computation of nonlinear partial differential equations from applied mathematics
[AD-A231188] N91-21806
PARTICLE ACCELERATION
Review of negative hydrogen ion sources
[DE91-009461] N91-21848
Experimental study project of plasma waves and turbulences
[INPE-5127-RPE/632] N91-21896
PARTICLE ACCELERATOR TARGETS
Electron distortion effects in quasi-elastic electron scattering
[DE91-009034] N91-21843
PARTICLE BEAMS
Geomagnetic model investigations for 1980 - 1989: A model for strategic defense initiative particle beam experiments and a study in the effects of data types and observatory bias solutions
[NASA-TM-104541] N91-21654
PARTICLE COLLISIONS
Corrections to the participant-spectator model of high-energy alpha-particle fragmentation
[NASA-TM-4262] N91-21860
PARTICLE EMISSION
Studies of synchrotron radiation emission from the NRL modified betatron accelerator
[AD-A231346] N91-21868
PARTICLE ENERGY
Studies of synchrotron radiation emission from the NRL modified betatron accelerator
[AD-A231346] N91-21868
PARTICLE IN CELL TECHNIQUE
The streamlined Darwin field method (and a solution technique that makes it practical)
[DE91-009482] N91-21903
PARTICLE INTERACTIONS
Integrable Hamiltonian system in 2N dimensions
[DE91-619585] N91-21798
Review of CERN heavy-ion physics
[DE91-009326] N91-21844
PARTICLE MOTION
Stabilities of regular motion in the relativistic standard map
[NIFS-73] N91-21894
PARTICLE PRODUCTION
Review of CERN heavy-ion physics
[DE91-009326] N91-21844
Strange particles production and absorption in nuclei at high energies
[DE91-620399] N91-21845
PARTICLE SIZE DISTRIBUTION
Redistribution of particulates on a payload during flight ascent
[NASA-TM-104539] N91-21255
Volcanism-Climate Interactions
[NASA-CP-10062] N91-21641
PARTICLE THEORY
Studies in clustering theory
[AD-A230967] N91-21475
PARTICULATE SAMPLING
Sample holder support for microscopes
[NASA-CASE-MFS-28420-1] N91-21545
PASSIVITY
Environmentally-induced passivity of aluminum alloys and aluminum metal matrix composites
[AD-A231350] N91-21301
EBIC (Electron Beam Induced Current) contrast of clean, decorated and deuterium passivated Si(Ge) epitaxial misfit dislocations
[DE91-006967] N91-21912
PATTERN RECOGNITION
Transitive, anti-symmetric relational attributes in structural description matching with applications to radar target identification
[AD-A231318] N91-21417
Feature matching for object localization in the presence of uncertainty
[AD-A231405] N91-21766
An efficient correspondence based algorithm for 2D and 3D model based recognition
[AD-A231406] N91-21767
Computing with neural networks: A comparison of the multi-layer perceptron and the hierarchical pattern recognition network for classification problems
[AD-A231584] N91-21768
First Annual Meeting of International Neural Network Society
[AD-A230283] N91-21777
Radar signal categorization using a neural network N91-21782
Image recovery by simulated annealing
[AD-A230655] N91-21869
PAYLOADS
Dynamic response of a hammerhead launch vehicle wind-tunnel model
[NASA-TM-104050] N91-21177
PEAT
Supervision of peat stockpiles using aerial thermography
[DE91-752966] N91-21622
PENDULUMS
Learning control of inverted pendulum system by neural network driven fuzzy reasoning: The learning function of NN-driven fuzzy reasoning under changes of reasoning environment N91-21785
PENETRATION
A comparison of calculational results with experimental data for long rod projectiles
[DE91-009006] N91-21536
PEPTIDES
Applications and current limitations of matrix-assisted laser desorption Fourier transform mass spectrometry for biomolecules
[DE91-008877] N91-21265
PERCOLATION
Studies in clustering theory
[AD-A230967] N91-21475
PERFORMANCE PREDICTION
A pressure based method for the solution of viscous incompressible turbomachinery flows N91-21078
Predicting F-14 Air Combat Maneuvering (ACM) performance using an automated battery of cognitive/psychomotor tests
[AD-A228593] N91-21128
Critical speeds and forced response solutions for active magnetic bearing turbomachinery, part 2 N91-21210
Large liquid rocket engine transient performance simulation system
[NASA-CR-184099] N91-21232
Design of experiments to quantify communication satellite system performance
[PB91-129635] N91-21395
Boundary layer study
[AD-A231343] N91-21482
A conceptual model of the performance of the United States Air Force flight training program
[AD-A230881] N91-21711
Theoretical investigation of energy storage in atomic and molecular systems: Metastable molecular fuels
[AD-A230854] N91-21852
PERFORMANCE TESTS
Evaluation of an alternative rotorcraft cargo lowering device for the delivery of 500-lb ammunition loads
[AD-A230995] N91-21133
An experimental study of exit flow patterns in a multistage compressor in rotating stall
[AD-A231353] N91-21143
O-ring gasket test fixture
[NASA-CASE-MFS-28376-1] N91-21175
Torsional suspension system for testing space structures
[NASA-CASE-LAR-14149-1-SB] N91-21176
Magnetic bearings for a spaceflight optical disk recorder N91-21195
Performance of small thrusters and propulsion systems
[AD-A231482] N91-21241
Material properties of silicon carbide fibers with continuously applied sol-gel alumina coatings
[AD-A230825] N91-21256
Fracture toughness of unidirectional fiber reinforced ceramic composites in Mode 2 utilizing laser interferometry
[AD-A231027] N91-21258

Transverse cracking in a fiber reinforced ceramic matrix composite
[AD-A231029] N91-21259
Long-term performance and propagation measurements on single and tandem digital microwave transmission links. Volume 1: Analysis of measurement data
[PB91-129643] N91-21396
Heat-rate improvements obtained with the use of enhanced tubes in surface condensers
[DE91-006565] N91-21449
Experimental response functions and response matrices for 2.54-cm x 2.54 cm and 7.62 cm x 7.62 cm bismuth germanate scintillation detectors
[AD-A230140] N91-21486
Navigation Experiment NAVEX: Measurement and performance of the spaceborne clocks
[ESA-TT-1209] N91-21823

PERIOD DOUBLING
Predicting chaos for infinite dimensional dynamical systems: The Kuramoto-Sivashinsky equation, a case study
[NASA-CR-187531] N91-21454

PERIODIC VARIATIONS
Climate variability and ecosystem response: Proceedings of a Long-Term Ecological Research Workshop
[PB91-119180] N91-21632
North Atlantic weather regimes: A synoptic study of phase space
[NASA-CR-188162] N91-21673

PERMANENT MAGNETS
Large gap magnetic suspension system N91-21201
Permanent magnet flux-biased magnetic actuator with flux feedback
[NASA-CASE-LAR-13785-1] N91-21824

PERSONNEL DEVELOPMENT
A guide to ground vehicle operations on the airport
[AD-A231077] N91-21158

PERSONNEL MANAGEMENT
Top quality management, reliability, and maintainability: Institutional goals with built in barriers
[AD-A230134] N91-21552

PERTURBATION THEORY
Effective computational strategy for predicting the response of complex systems
[AD-A231153] N91-21441
Theoretical study of the radiative lifetime for the spin-forbidden transition a3 (sigma u +) to X1 (sigma g +) in He2
[AD-A230956] N91-21854

PETROLEUM PRODUCTS
Use of natural gas and liquefied petroleum gas in heavy-duty engines
[DE91-752990] N91-21546

PETROLOGY
Sources of volcanic aerosols: Petrologic and volcanological constraints N91-21644

PHASE DETECTORS
Phase-lock-loop application for fiber optic receiver
[NASA-TM-102776] N91-21435

PHASE DIAGRAMS
High efficiency surface-emitting semiconductor laser resonators
[DE91-005236] N91-21510
Critical behavior in magnetic superlattices
[AD-A231327] N91-21925

PHASE ERROR
Automatic program correction of interferometry quadratic sensor errors. Application to the processing of signals from a VISAR interferometer
[ISL-R-127/89] N91-21799

PHASE LOCKED SYSTEMS
Phase-lock-loop application for fiber optic receiver
[NASA-TM-102776] N91-21435

PHASE SHIFT
L-band antenna array with integrated phase shifters
[ESA-TT-1215] N91-21405
Frequency response calibration of recess-mounted pressure transducers
[NASA-TM-104031] N91-21834

PHASE TRANSFORMATIONS
Structural characterization of the Ag/YBa2Cu3O(7-x) interface
[DE91-009112] N91-21907

PHASED ARRAYS
Operation, maintenance, and research activities at NORSAR, NORESS, and ARCESS
[AD-A230874] N91-21970

PHOSPHATES
Nonlinear optical spectroscopy of Ce3(+) ions in insulating crystals
[DE91-008928] N91-21913

PHOTOACOUSTIC SPECTROSCOPY
New Cologne acousto-optical spectrometer projects N91-22034
Airborne heterodyne receiver for the range 600 GHz to 3,000 GHz N91-22047

PHOTOCATHODES
High current photoemission with 10 picosecond UV pulses
[DE91-009439] N91-21515

PHOTOCHEMICAL REACTIONS
Photochemistry and charge transfer chemistry of the platinum group elements
[DE91-009153] N91-21277
Photoassisted reaction of H2 with CO2 over solid catalysts
[AD-A231045] N91-21282
A center for the study of early events in photosynthesis
[DE91-008509] N91-21698

PHOTOCONDUCTIVITY
Observation of the photorefractive effect in a polymer
[AD-A231339] N91-21322

PHOTODIODES
High current photoemission with 10 picosecond UV pulses
[DE91-009439] N91-21515

PHOTODISSOCIATION
The stucture of molecular clouds: New questions N91-22011
A highly collimated bipolar outflow in the core of OMC-1: CO submillimeter emission N91-22014
Interstellar chemistry and submillimetre astronomy N91-22021

PHOTOELECTRIC EMISSION
High brightness electron beam production by laser induced various order multiphoton photoeffects of gold
[DE91-009150] N91-21514
High current photoemission with 10 picosecond UV pulses
[DE91-009439] N91-21515
The production and destruction of negative ions
[DE91-009517] N91-21850

PHOTOELECTRON SPECTROSCOPY
Ultraviolet photoelectron spectra of gallium arsenide clusters
[AD-A224927] N91-21261
Effective cleaning of oil-protected bearing steel examined by XPS analysis. Part 1: Cleaning by solvents and alkaline cleaners
[NAL-TR-1074] N91-21538
Photoelectron spectroscopy of Si2
[AD-A230911] N91-21853

PHOTOELECTRONS
Ultraviolet photoelectron spectra of gallium arsenide clusters
[AD-A224927] N91-21261

PHOTOGEOLOGY
Volcanic-sedimentary sequence of the Greenstone Belt type in the Santa Rita or Goias elevation: An approach with TM-Landsat data
[INPE-5178-PRE/1647] N91-21610

PHOTOGRAMMETRY
Design and development of the terrain information extraction system
[AD-A231166] N91-21623

PHOTOLYSIS
In vitro photoreactivation of transforming DNA of Bacillus subtilis spores after irradiation by ultraviolet light
[ESA-TT-1210] N91-21699

PHOTOMETERS
A high throughput, multiband photometer for the TIR project N91-22042

PHOTOMETRY
Submillimeter observations with the Kuiper Airborne Observatory N91-21987
Sub-mm direct photometry with large telescopes N91-22027
Submillimetre photometry of comets N91-22052

PHOTONICS
Test report for photonic sensors used in electric field measurement of simulated electromagnetic pulses
[AD-A231597] N91-21422

PHOTONS
Test report for photonic sensors used in electric field measurement of simulated electromagnetic pulses
[AD-A231597] N91-21422
Theory of photon and electron induced reactions
[DE91-008993] N91-21842

PHOTONUCLEAR REACTIONS
Proceedings of the Gordon Conference on Photonuclear Reactions
[DE91-621717] N91-21846

PHOTOPRODUCTION
Theory of photon and electron induced reactions
[DE91-008993] N91-21842

PHOTOSYNTHESIS
A center for the study of early events in photosynthesis
[DE91-008509] N91-21698

PHOTOVOLTAIC CELLS
Power optimal single-axis articulating strategies
[NASA-CR-187510] N91-21581

PHYSICAL OPTICS
Optical scattering methods applicable to drops and bubbles N91-21358

PHYSIOLOGICAL EFFECTS
Exploring the living universe: A strategy for space life sciences
[NASA-TM-103399] N91-21696
The physiological effects of 50/60 Hz electromagnetic fields: Standards and guidelines
[DE91-752996] N91-21705
Life sciences on-line: A study in hypermedia application N91-21943
Proton depth dose distribution: 3-D calculation of dose distributions from solar flare irradiation
[AD-A231230] N91-22061

PHYSIOLOGICAL RESPONSES
Physiology data acquisition system description
[AD-A231088] N91-21706

PHYSIOLOGICAL TESTS
A field evaluation of the compatibility of the protective integrated hood mask with ANVIS night vision goggles
[AD-A230237] N91-21718

PICOSECOND PULSES
High current photoemission with 10 picosecond UV pulses
[DE91-009439] N91-21515

PIEZOELECTRIC TRANSDUCERS
One way to reduce thermal effects in a piezoelectric pressure transducer mounted in the combustion chamber of a C.I. engine
[ISVR-TR-189] N91-21487

PILOT PERFORMANCE
Predicting F-14 Air Combat Maneuvering (ACM) performance using an automated battery of cognitive/psychomotor tests
[AD-A228593] N91-21128
National plan for aviation human factors, volume 1
[PB91-100339] N91-21712

PILOT TRAINING
Enhancing tolerance to acceleration (+Gz) stress: The Hook maneuver
[AD-A231094] N91-21707
High G physiological protection training
[AGARD-AG-322] N91-21720

PILOTLESS AIRCRAFT
Effectiveness of bomber deployed autonomous airborne vehicles in finding rail mobile SS-24s
[DE91-009008] N91-21815

PIPELINING (COMPUTERS)
Test results of a 90 MHz integrated circuit sixteen channel analog pipeline for SSC detector calorimetry
[DE91-009773] N91-21436

PIPES (TUBES)
A dynamic technique for measuring surface tension at high temperatures in microgravity environment N91-21347

PITCH (INCLINATION)
Determination of pitch and roll angles with respect to a point on earth surface
[INPE-5206-PRE/1668] N91-21215

PITCHING MOMENTS
Computer program for the calculation of normal force and pitching moment of forebody-cylinder combinations at angles of attack up to 90 degrees and Mach numbers up to 5, including effects of conical boat-tailing
[ESDU-90034] N91-21102

PITTING
A study of the inhibition of pitting of aluminum by chromate
[DE91-006915] N91-21294
In-situ x ray measurements of pit solutions during localized corrosion
[DE91-006916] N91-21295

PLANAR STRUCTURES
Stability considerations for magnetic suspension systems using electromagnets mounted in a planar array N91-21202
A plane-sweep algorithm for exact simulation of a quasi-static mechanical system of compliantly-connected rigid bodies (extended abstract)
[AD-A231324] N91-21550

PLANETARY ATMOSPHERES
Laboratory evaluation and application of microwave absorption properties under simulated conditions for planetary atmospheres
[NASA-CR-188096] N91-22057

PLANETARY BOUNDARY LAYER
Estimations of ABL fluxes and other turbulence parameters from Doppler lidar data
[NASA-CR-188062] N91-21648

PLANETARY IONOSPHERES
Data analysis for the Pioneer-Venus electric field detector
[NASA-CR-188099] N91-22056
PLANETARY NEBULAE
First detection of C3H2 at sub-mm wavelengths N91-22022
PLANETARY ORBITS
Parametric entry corridors for lunar/Mars aerocapture missions
[NASA-TM-102178] N91-21168
PLANETS
Submillimetre observations of solar-system objects N91-22037
PLANNING
National plan for aviation human factors, volume 1
[PB91-100339] N91-21712
PLASMA CLOUDS
The study of plasma clouds around large active space structures
[AD-A230634] N91-21881
PLASMA COMPOSITION
High density regimes and beta limits in JET
[DE91-005490] N91-21885
Recent JET results and future prospects
[DE91-005474] N91-21897
PLASMA CONTROL
Study of asymmetrical electric discharges using particle simulation
[INPE-5198-TDL/427] N91-21432
The Basis version of LASNEX
[DE91-009483] N91-21516
Sawteeth and their stabilization in JET
[DE91-005459] N91-21882
High performance H modes in JET
[DE91-005488] N91-21883
High density regimes and beta limits in JET
[DE91-005490] N91-21885
Transport in auxiliary-heated, hot-ion H-mode and L-mode discharges in the DIII-D tokamak
[DE91-008924] N91-21887
Role of the edge electric field and microturbulence in the L-H transition
[DE91-008925] N91-21888
Recent JET results and future prospects
[DE91-005474] N91-21897
Some observations concerning alpha instabilities and driven tokamak reactors
[DE91-008628] N91-21898
Kinetic stability of field-reversed configurations
[DE91-009530] N91-21901
The streamlined Darwin field method (and a solution technique that makes it practical)
[DE91-009482] N91-21903
PLASMA CURRENTS
Design and construction of a formed pulse circuit for a plasma centrifuge
[INPE-5161-RPE/639] N91-21895
PLASMA CYLINDERS
Study of asymmetrical electric discharges using particle simulation
[INPE-5198-TDL/427] N91-21432
PLASMA DENSITY
Plasma contactor research, 1990
[NASA-CR-187097] N91-21880
High density regimes and beta limits in JET
[DE91-005490] N91-21885
PLASMA DIAGNOSTICS
Plasma contactor research, 1990
[NASA-CR-187097] N91-21880
Colorado School of Mines fusion gamma ray diagnostic project
[DE91-009259] N91-21889
Laser diagnostics for plasma turbulence
[DE91-009377] N91-21899
PLASMA DRIFT
Effect of electric field inhomogeneities on drift wave instabilities and anomalous transport
[NIFS-72] N91-21893
PLASMA ELECTRODES
Study of asymmetrical electric discharges using particle simulation
[INPE-5198-TDL/427] N91-21432
PLASMA HEATING
High performance H modes in JET
[DE91-005488] N91-21883
ICRF heating in reactor grade plasmas
[DE91-005491] N91-21886
Recent JET results and future prospects
[DE91-005474] N91-21897
PLASMA JETS
Transport in auxiliary-heated, hot-ion H-mode and L-mode discharges in the DIII-D tokamak
[DE91-008924] N91-21887
PLASMA POTENTIALS
Plasma contactor research, 1990
[NASA-CR-187097] N91-21880
PLASMA TURBULENCE
Role of the edge electric field and microturbulence in the L-H transition
[DE91-008925] N91-21888
Experimental study project of plasma waves and turbulences
[INPE-5127-RPE/632] N91-21896
Laser diagnostics for plasma turbulence
[DE91-009377] N91-21899
PLASMA WAVES
Modeling the absorption of intense, short laser pulses in steep density gradients
[DE91-008735] N91-21503
Data analysis for the Pioneer-Venus electric field detector
[NASA-CR-188099] N91-22056
PLASMA-ELECTROMAGNETIC INTERACTION
Norwegian studies of plasma modifications around spacecraft and how these affect the vehicle potential N91-21166
PLASMAS (PHYSICS)
High reliability megawatt transformer/rectifier
[NASA-CR-187079] N91-21430
ICRF heating in reactor grade plasmas
[DE91-005491] N91-21886
Design and construction of a formed pulse circuit for a plasma centrifuge
[INPE-5161-RPE/639] N91-21895
PLASTIC DEFORMATION
Deformation substructures induced by high-rate deformation
[DE91-008595] N91-21288
Tribological performance and deformation of sputter-deposited MoS2 solid lubricant films during sliding wear and indentation contact
[AD-A231003] N91-21547
PLATEAUS
Registration of windfall damage in the eastern Hunsrueck Plateau (Fed. Republic of Germany) utilizing LANDSAT TM data: A landscape-ecological analysis for practical forestry
[DLR-FB-90-31] N91-21601
PLATENS
Five degree-of-freedom control of an ultra-precision magnetically-suspended linear bearing N91-21196
PLATES
Fully articulated four-point-bend loading fixture
[NASA-CASE-LEW-14776-1] N91-21540
PLATES (STRUCTURAL MEMBERS)
Large deformation behavior of long shallow cylindrical composite panels
[NASA-CR-4355] N91-21557
Thermal buckling and postbuckling of symmetrically laminated composite plates
[NASA-CR-188030] N91-21560
Stacking-sequence optimization for buckling of laminated plates by integer programming
[NASA-TM-104033] N91-21580
PLATES (TECTONICS)
Report of the panel on plate motion and deformation, section 2 N91-21591
PLATINUM
Potentiometric titration of gold, platinum, and some other precious metals
[DE91-008989] N91-21276
PLATINUM COMPOUNDS
Photochemistry and charge transfer chemistry of the platinum group elements
[DE91-009153] N91-21277
PLUMES
Kalman filter tracking of a reflective target using forward looking infrared measurements and laser illumination
[AD-A231196] N91-21524
User's manual for SLAB: An atmospheric dispersion model for denser-than-air-releases
[DE91-008443] N91-21638
PLUTONIUM OXIDES
Post-encapsulation plutonia reduction for Galileo and Ulysses GPHS modules: The Module Reduction and Monitoring Facility (MRMF)
[DE91-008131] N91-21861
PLY ORIENTATION
Stacking-sequence optimization for buckling of laminated plates by integer programming
[NASA-TM-104033] N91-21580
POINT SOURCES
Compilation of air pollutant emission factor. Volume 1, supplement C: Stationary point and area sources, fourth edition
[PB91-125906] N91-21630
POINTING CONTROL SYSTEMS
Magnetic suspension systems for space applications N91-21189
Advanced magnetic suspensions for vibration isolation and fast-attitude control of space-based generic pointing mounts N91-21190
Sliding mode control of magnetic suspensions for precision pointing and tracking applications N91-21193
Aerospace Applications of Magnetic Suspension Technology, part 2
[NASA-CP-10066-PT-2] N91-21203
Dynamic and control assessment of the Space Station Freedom payload pointing system
[NASA-TM-101667] N91-21225
The James Clerk Maxwell telescope N91-22031
POISSON EQUATION
Normalized convergence rates for the PSMG method
[AD-A231311] N91-21764
POLAR REGIONS
Polar research from satellites
[NASA-CR-188025] N91-21640
POLARIZATION (CHARGE SEPARATION)
Contributions of conformational and structural defects to the hyper-polarizabilities of polymers
[DE91-009042] N91-21313
POLARIZED LIGHT
NCTM of liquids at high temperatures using polarization techniques N91-21345
POLARIZED RADIATION
Enhanced selectivity and detectability in absorption and fluorescence methods based on polarization modulation
[DE91-008926] N91-21279
Studies of synchrotron radiation emission from the NRL modified betatron accelerator
[AD-A231346] N91-21868
POLARONS
The organic chemistry of conducting polymers
[DE91-009520] N91-21316
POLICIES
Bibliography on the international network of biosphere reserves
[PB90-215518] N91-21600
POLLUTION TRANSPORT
Adaptation of the Advanced Statistical Trajectory Regional Air Pollution (ASTRAP) model to the EPA VAX computer: Modifications and testing
[PB91-127720] N91-21631
POLYACETYLENE
The organic chemistry of conducting polymers
[DE91-009520] N91-21316
POLYATOMIC MOLECULES
Chaotic spectra of small molecules
[AD-A231638] N91-21859
POLYCRYSTALS
The nucleation and growth of polycrystalline silicon carbide
[DE91-008887] N91-21304
POLYMER CHEMISTRY
The organic chemistry of conducting polymers
[DE91-009520] N91-21316
Strength of polymer interfaces
[AD-A230839] N91-21318
Observation of the photorefractive effect in a polymer
[AD-A231339] N91-21322
POLYMERIC FILMS
Electronic and ionic transport in processable conducting polymers
[AD-A231293] N91-21321
POLYMERIZATION
Organic aerogels: A new type of ultrastructured polymer
[DE91-008500] N91-21312
Tractable high performance polymers
[AD-A231072] N91-21320
POLYMERS
Organic aerogels: A new type of ultrastructured polymer
[DE91-008500] N91-21312
Fundamental investigation of micelles and microemulsions in supercritical fluids
[AD-A231073] N91-21476
POLYNOMIALS
Uniform high order spectral methods for one and two dimensional Euler equations
[NASA-CR-187535] N91-21456
Feature matching for object localization in the presence of uncertainty
[AD-A231405] N91-21766
An efficient correspondence based algorithm for 2D and 3D model based recognition
[AD-A231406] N91-21767
POLYNUCLEOTIDES
Applications and current limitations of matrix-assisted laser desorption Fourier transform mass spectrometry for biomolecules
[DE91-008877] N91-21265

POLYPHENYLS
Electronic and ionic transport in processable conducting polymers
[AD-A231293] N91-21321
POLYURETHANE RESINS
Synthesis, structure, and properties of segmented polyurethanes
[AD-A230966] N91-21319
POROSITY
Lift and rolling moment due to spoilers on wings at subsonic speeds
[ESDU-90030] N91-21129
POSITION (LOCATION)
The spacecraft control laboratory experiment optical attitude measurement system
[NASA-TM-102624] N91-21186
System and method for measuring ocean surface currents at locations remote from land masses using synthetic aperture radar
[NASA-CASE-NPO-17937-1-CU] N91-21621
Calibration transfer target for a microwave radiometric profiling system
[PB91-129080] N91-21647
Feature matching for object localization in the presence of uncertainty
[AD-A231405] N91-21766
POSITIONING
Assessment of the absolute accuracy of long-baseline kinematic GPS positioning of a moving vehicle
[PB91-129379] N91-21125
Ground-based and microgravity containerless positioning technologies and facilities N91-21333
Feedback controlled electrostatic and electromagnetic sample positioners N91-21370
A computer model of the electrostatic positioning system N91-21371
Some considerations for various positioning systems and their science capabilities N91-21372
Alignment positioning mechanism
[NASA-CASE-MSC-21502-1] N91-21543
POSITIONING DEVICES (MACHINERY)
Containerless protein crystal growth technology: Electrostatic multidrop positioner N91-21352
POSTFLIGHT ANALYSIS
Flight set 360L007 (STS-33) insulation component. Volume 3: Final release
[NASA-CR-184091] N91-21230
Flight motor set 360T010 (STS-31R). Volume 1: System overview
[NASA-CR-184104] N91-21231
POTENTIOMETRIC ANALYSIS
Potentiometric titration of gold, platinum, and some other precious metals
[DE91-008989] N91-21276
POWDER METALLURGY
Controlling fundamentals in high-energy high-rate pulsed power materials processing of powdered tungsten, titanium aluminides, and copper-graphite composites
[AD-A230900] N91-21298
Mechanical strength and thermophysical properties of PM212: A high temperature self-lubricating powder metallurgy composite
[NASA-TM-103694] N91-21302
POWER AMPLIFIERS
GaAs monolithic RF modules for SARSAT distress beacons
[NASA-TM-104338] N91-21184
Estimating power amplifier large signal gain
[AD-A230823] N91-21437
POWER CONDITIONING
Power optimal single-axis articulating strategies
[NASA-CR-187510] N91-21581
POWER GAIN
Noise factor and antenna gains in the signal/noise equation for over-the-horizon radar
[AD-A231203] N91-21416
POWER LINES
Survey on electron beam processing technologies
[DE91-759126] N91-21866
POWER SPECTRA
Power spectra of internal gravity waves
[AD-A231596] N91-21659
Frequency response calibration of recess-mounted pressure transducers
[NASA-TM-104031] N91-21834
POWER SUPPLY CIRCUITS
A solid-state controllable power supply for a magnetic suspension wind tunnel N91-21199
PRECESSION
The gravitomagnetic interaction and its relationship to other relativistic gravitational effects
[NASA-CR-187736] N91-21649
PRECIPITATION (METEOROLOGY)
Using climate model output to assess the impacts of climate change on water resources
[DE91-004542] N91-21637
PREDICTION ANALYSIS TECHNIQUES
Computational modelling of dump combustors flowfield N91-21096
A highly efficient engineering tool for three-dimensional scramjet flowfield and heat transfer computations N91-21098
Computer program for the calculation of normal force and pitching moment of forebody-cylinder combinations at angles of attack up to 90 degrees and Mach numbers up to 5, including effects of conical boat-tailing
[ESDU-90034] N91-21102
Wind tunnel test of a propeller working in a low Reynolds number range
[NAL-TR-1071] N91-21112
Lift and rolling moment due to spoilers on wings at subsonic speeds
[ESDU-90030] N91-21129
Mechanical behavior of fiber reinforced SiC/RBSN ceramic matrix composites: Theory and experiment
[NASA-TM-103688] N91-21243
Impact damage in curved graphite/epoxy panels with clamped edges
[AD-A230853] N91-21257
Analysis and testing of a bistatic radar cross section measurement capability for the AFIT anechoic chamber
[AD-A230609] N91-21401
Radio wave propagation modeling, prediction and assessment
[AGARD-AG-326] N91-21404
Effective computational strategy for predicting the response of complex systems
[AD-A231153] N91-21441
Variational method in the statistical theory of turbulence
[AD-A231621] N91-21484
Superconducting Super Collider silicon tracking subsystem research and development
[DE91-009227] N91-21862
PREDICTIONS
Predicting chaos for infinite dimensional dynamical systems: The Kuramoto-Sivashinsky equation, a case study
[NASA-CR-187531] N91-21454
Current velocity and hydrographic observations in the southwestern North Atlantic Ocean: Subtropical Atlantic Climate Studies (STACS), 1989
[PB91-115535] N91-21685
Effectiveness of bomber deployed autonomous airborne vehicles in finding rail mobile SS-24s
[DE91-009008] N91-21815
PREDICTOR-CORRECTOR METHODS
Effective computational strategy for predicting the response of complex systems
[AD-A231153] N91-21441
A multiblock multigrid three-dimensional Euler equation solver
[NASA-TM-103424] N91-21795
PRELAUNCH TESTS
Shuttle Entry Air Data System (SEADS) hardware development. Volume 1: Summary
[NASA-CR-166044-VOL-1] N91-21179
Shuttle Entry Air Data System (SEADS) hardware development. Volume 2: History
[NASA-CR-166044-VOL-2] N91-21180
PREMIXED FLAMES
The PDF method for turbulent combustion N91-21080
PRESSURE DEPENDENCE
Pressure dependence of deep centers by capacitance spectroscopies inside the diamond anvil cell
[DE91-008927] N91-21906
PRESSURE DISTRIBUTION
Pressure algorithm for elliptic flow calculations with the PDF method N91-21081
PRESSURE EFFECTS
Zonal analysis of two high-speed inlets N91-21089
Study of the absorption lines widened by the effect of pressure, emitted by the combustion gases of propulsive powders
[ISL-R-124/89] N91-21237
Constant-current stagnation-point film-anemometer probe
[AD-A231048] N91-21501
Ventilation loss and pressurization in the NASA launch/entry suit: Potential for heat stress
[NASA-CR-188075] N91-21719
PRESSURE GRADIENTS
Experimental and theoretical studies of vertical annular liquid jets
[DE91-008042] N91-21461
PRESSURE MEASUREMENT
Volumetric measurement of tank volume
[NASA-CASE-MSC-21500-1] N91-21493
Tank gauging apparatus and method
[NASA-CASE-MSC-21059-3] N91-21495
PRESSURE OSCILLATIONS
North Atlantic weather regimes: A synoptic study of phase space
[NASA-CR-188162] N91-21673
PRESSURE RATIO
The 3D computation of single-expansion-ramp and scramjet nozzles N91-21092
An experimental study of exit flow patterns in a multistage compressor in rotating stall
[AD-A231353] N91-21143
PRESSURE REDUCTION
Entry vehicle performance analysis and atmospheric guidance algorithm for precision landing on Mars
[AD-A231585] N91-21228
Volumetric measurement of tank volume
[NASA-CASE-MSC-21500-1] N91-21493
PRESSURE SENSORS
Shuttle Entry Air Data System (SEADS) hardware development. Volume 1: Summary
[NASA-CR-166044-VOL-1] N91-21179
Shuttle Entry Air Data System (SEADS) hardware development. Volume 2: History
[NASA-CR-166044-VOL-2] N91-21180
One way to reduce thermal effects in a piezoelectric pressure transducer mounted in the combustion chamber of a C.I. engine
[ISVR-TR-189] N91-21487
Frequency response calibration of recess-mounted pressure transducers
[NASA-TM-104031] N91-21834
PRESSURE VESSELS
Use of natural gas and liquefied petroleum gas in heavy-duty engines
[DE91-752990] N91-21546
PRINCIPAL COMPONENTS ANALYSIS
Production of image proportions through a linear mixing model
[INPE-5170-PRE/1639] N91-21615
PRINTED CIRCUITS
Resistance seam welding thin copper foils
[DE91-008988] N91-21535
PRIORITIES
Technology transfer needs assessment, 1990
[PB91-125674] N91-21985
PROBABILITY DENSITY FUNCTIONS
The PDF method for turbulent combustion N91-21080
Pressure algorithm for elliptic flow calculations with the PDF method N91-21081
PROBABILITY DISTRIBUTION FUNCTIONS
Probability distribution functions in turbulent convection
[NASA-CR-187519] N91-21453
PROBABILITY THEORY
The PDF method for turbulent combustion N91-21080
Study of bird ingestions into small inlet area aircraft turbine engines
[DOT/FAA/CT-90/13] N91-21122
Definition of the concept of an interferometric spectrum analyzer for the detection of frequency hopping radios
[AD-A231031] N91-21413
Probability estimates of cloud-obscured line-of-sight
[AD-A231151] N91-21678
Self-organization and clustering algorithms N91-21783
Classification of intermittent dependent observations
[AD-A231605] N91-21811
Adaptive detection in subspaces
[AD-A231023] N91-21876
PROBLEM SOLVING
Numerical analysis and computation of nonlinear partial differential equations from applied mathematics
[AD-A231188] N91-21806
PROCESS CONTROL (INDUSTRY)
Real-time measurement of materials properties at high temperatures by laser produced plasmas N91-21342
Single board system for fuzzy inference N91-21784
PROCESS HEAT
Process integration: Process change and batch processes
[ESDU-90033] N91-21390
PROCUREMENT MANAGEMENT
Decision support environment for concurrent engineering requirements
[AD-A230899] N91-21555
PRODUCT DEVELOPMENT
Quality function deployment in launch operations
[AD-A230983] N91-21178
Development of a gas engine-driven chiller
[PB91-130237] N91-21389
Engineering software development with HyperCard N91-21942
PRODUCTION ENGINEERING
Quality function deployment in launch operations
[AD-A230983] N91-21178

PROGRAM VERIFICATION (COMPUTERS)
OD system for the first Brazilian satellite-software testing, analysis, and assessment
[INPE-5158-PRE/1637] N91-21169
The fast Hartley transform
[AD-A230370] N91-21400
Methodology development for the verification and validation of flight critical systems software, phase 1
[AD-A229932] N91-21735
Graphical representation of parallel algorithmic processes
[AD-A231258] N91-21760
PROGRAMMING LANGUAGES
Experience with abstract notation one
[NASA-CR-188090] N91-21741
VHSIC Hardware Description Language (VHDL) benchmark suite
[AD-A231276] N91-21761
A heterogeneous parallel programming capability
[AD-A229710] N91-21772
Documentation for the token ring network simulation system
[NASA-CR-188093] N91-21789
AiGERM: A logic programming front end for GERM N91-21957
PROJECT MANAGEMENT
Exploring the living universe: A strategy for space life sciences
[NASA-TM-103399] N91-21696
Software development standards for project cost management information system
[AD-A231282] N91-21762
Administrative information systems plan, FY 1991 - FY 1995
[DE91-008072] N91-21964
PROJECT PLANNING
Kauai Test Facility two experiment rocket campaign
[DE91-008894] N91-21172
PROJECTILES
Practical methods to evaluate the friction drag coefficient of a projectile in free flight
[ISL-R-123/89] N91-21105
Deep overheating of thin bodies in flight with very low-angled trajectory
[ISL-R-126/89] N91-21107
A comparison of calculational results with experimental data for long rod projectiles
[DE91-009006] N91-21536
PROPELLANT CHEMISTRY
Theoretical investigation leading to energy storage in atomic and molecular systems
[AD-A231275] N91-21858
PROPELLANT EXPLOSIONS
Heats of explosion at low pressures, 2
[AD-A231020] N91-21328
PROPELLANTS
Basic rheology and its application to nitrocellulose propellant processing by screw mix-extruders
[AD-A230872] N91-21326
Theoretical studies of highly energetic CBES materials
[AD-A231340] N91-21329
PROPELLER BLADES
Wind tunnel test of a propeller working in a low Reynolds number range
[NAL-TR-1071] N91-21112
Structural analysis and optimization of a propfan blade by use of the finite element method
[ESA-TT-1216] N91-21566
Acoustic and aerodynamic study of a pusher-propeller aircraft model
[NASA-TP-3040] N91-21828
PROPELLER NOISE
Acoustic and aerodynamic study of a pusher-propeller aircraft model
[NASA-TP-3040] N91-21828
PROPELLER SLIPSTREAMS
Low speed wind tunnel investigation of propeller slipstream aerodynamic effects on different nacelle/wing combinations. Part 2: Propeller slipstream flow field surveys (velocity components, dynamic, total and static pressure distributions) at zero angle of attack and high power
[FFA-TN-1990-24-PT-2] N91-21109
PROPELLERS
Wind tunnel test of a propeller working in a low Reynolds number range
[NAL-TR-1071] N91-21112
PROPORTIONAL CONTROL
Principle, advantages and disadvantages of a dc Current Transformer (DCCT)
[DIGEL-1990-5] N91-21431
PROPULSION SYSTEM CONFIGURATIONS
Large liquid rocket engine transient performance simulation system
[NASA-CR-184099] N91-21232
Space vehicle propulsion systems: Environmental space hazards
[NASA-CR-188094] N91-21236
CFD for hypersonic propulsion
[NASA-TM-103791] N91-21447
Boundary layer study. Phase 4: Experimental validation test plan
[AD-A231342] N91-21481
Boundary layer study
[AD-A231343] N91-21482
PROPULSION SYSTEM PERFORMANCE
Computational Fluid Dynamics Symposium on Aeropropulsion
[NASA-CP-3078] N91-21062
A highly efficient engineering tool for three-dimensional scramjet flowfield and heat transfer computations N91-21098
Propulsion simulator for magnetically-suspended wind tunnel models N91-21198
Large liquid rocket engine transient performance simulation system
[NASA-CR-184099] N91-21232
Space vehicle propulsion systems: Environmental space hazards
[NASA-CR-188094] N91-21236
Performance of small thrusters and propulsion systems
[AD-A231482] N91-21241
A preliminary evaluation of an F100 engine parameter estimation process using flight data
[NASA-TM-4216] N91-21446
CFD for hypersonic propulsion
[NASA-TM-103791] N91-21447
Application of computational fluid dynamics in high speed aeropropulsion
[NASA-TM-103780] N91-21458
Boundary layer study
[AD-A231343] N91-21482
PROPULSIVE EFFICIENCY
Performance of small thrusters and propulsion systems
[AD-A231482] N91-21241
Application of computational fluid dynamics in high speed aeropropulsion
[NASA-TM-103780] N91-21458
Theoretical investigation of energy storage in atomic and molecular systems: Metastable molecular fuels
[AD-A230854] N91-21852
PROTECTIVE CLOTHING
A compatibility assessment of the protective integrated hood mask with ANVIS night vision goggles
[AD-A229956] N91-21716
PROTECTIVE COATINGS
UV cured epoxy resin coatings
[DE91-008180] N91-21303
PROTEIN CRYSTAL GROWTH
Containerless protein crystal growth technology: Electrostatic multidrop positioner N91-21352
PROTEINS
High-performance capillary electrophoresis of histones
[DE91-008585] N91-21275
PROTOCOL (COMPUTERS)
Issues in providing a reliable multicast facility
[NASA-CR-188089] N91-21403
Experience with abstract notation one
[NASA-CR-188090] N91-21741
Documentation for the token ring network simulation system
[NASA-CR-188093] N91-21789
Analysis of exhaustive limited service for token ring networks
[NASA-CR-188092] N91-21790
XTP for the NASA space station
[NASA-CR-188087] N91-21966
PROTON IRRADIATION
Proton depth dose distribution: 3-D calculation of dose distributions from solar flare irradiation
[AD-A231230] N91-22061
PROTONS
Colorado School of Mines fusion gamma ray diagnostic project
[DE91-009259] N91-21889
PROTOPLASM
Fundamental investigation of micelles and microemulsions in supercritical fluids
[AD-A231073] N91-21476
PROTOSTARS
The search for protostars in high mass star forming regions N91-22030
PROTOTYPES
A study of helium. Argon: Ethane gas mixtures used in drift chambers for large acceptance spectrometers in high magnetic fields
[AD-A231209] N91-21284
A demonstration of CMOS VLSI circuit prototyping in support of the site facility using the 1.2 micron standard cell library developed by National Security Agency
[NASA-CR-188014] N91-21426
Calibration transfer target for a microwave radiometric profiling system
[PB91-129080] N91-21647
HEAVENS system for software artifacts N91-21958
PROVING
An empirical evaluation of analytical models for parallel relational database queries
[AD-A230813] N91-21752
PSYCHOLOGICAL FACTORS
Acquisition and production of skilled behavior in dynamic decision-making tasks
[NASA-CR-188084] N91-21939
PSYCHOLOGICAL TESTS
Predicting F-14 Air Combat Maneuvering (ACM) performance using an automated battery of cognitive/psychomotor tests
[AD-A228593] N91-21128
PSYCHOMOTOR PERFORMANCE
Predicting F-14 Air Combat Maneuvering (ACM) performance using an automated battery of cognitive/psychomotor tests
[AD-A228593] N91-21128
The development of perceptual/motor and cognitive performance measures under a high-G environment: A preliminary study
[AD-A231289] N91-21709
PUBLIC SPEAKING
Improving risk communication through interactive training in communication skills
[DE91-008366] N91-21402
PULSE COMPRESSION
Implementation of FFT and pulse compression routines on the SPT frequency domain array processor
[AD-A231320] N91-21443
Laser pulse compression in strontium and calcium vapor
[DE91-007346] N91-21511
PULSE GENERATORS
Grid pulse generator
[DIGEL-1990-6] N91-21863
PULSE RADAR
UHF model simulation of detecting voids in a dielectric medium using HF-VHF airborne short-pulse radar
[AD-A231495] N91-21418
PULSED LASERS
The micrometeoroid impact hazard in space: Techniques for damage simulation by pulsed lasers and environmental modelling N91-21220
Modeling the absorption of intense, short laser pulses in steep density gradients
[DE91-008735] N91-21503
High current photoemission with 10 picosecond UV pulses
[DE91-009439] N91-21515
PULSES
The theory of temporal compression of intense pulses in a metal vapor
[DE91-005059] N91-21509
Laser pulse compression in strontium and calcium vapor
[DE91-007346] N91-21511
Amplification of femtosecond pulses using a N2 pump laser
[DE91-008413] N91-21513
PURIFICATION
High-temperature metal purification using a compact, portable rf heating and levitation system on the wake shield N91-21363
High temperature metal purification using a compact portable rf heating and levitation system on the wake shield N91-21365
PYRIDINES
Comparison of the activity of subsurface and surface microorganisms and their anaerobic transformation of heterocyclic compounds
[DE91-008839] N91-21703
PYROLYSIS
Chemical spray pyrolysis of Tl-Ba-Ca-Cu-O high-T(sub c) superconductors for high-field bitter magnets N91-21212
Growth and characterization of thin films of Y2O3, La2O3 and La2CuO4
[AD-A231046] N91-21919
Preparation and characterization of Iron(III) oxide films by an novel spray pyrolysis method
[AD-A231047] N91-21920
PYROMETERS
A high-speed spatial (linear) scanning pyrometer: A tool for diagnostics, temperature mapping, and property determinations at high temperatures N91-21361

PYROTECHNICS
Effect of equations of state on transient burning analysis of pyrotechnic materials in a closed system
[DE91-009167] N91-21280
Combustion tests of black-powder substitutes for the hand-held signal flare
[AD-A231501] N91-21330
PYRROLES
Electronic and ionic transport in processable conducting polymers
[AD-A231293] N91-21321

Q

QUADRUPOLES
Rheological properties, shape oscillations, and coalescence of liquid drops with surfactants N91-21357
The sound of moving bodies
[NASA-TM-103342] N91-21827
Construction of flowing afterglow apparatus
[AD-A231062] N91-21855
QUALIFICATIONS
How clean is clean. How clean is needed
[DE91-008173] N91-21391
QUALITATIVE ANALYSIS
Analytical chemistry laboratory
[DE91-008986] N91-21266
High-performance capillary electrophoresis of histones
[DE91-008585] N91-21275
QUALITY CONTROL
Quality function deployment in launch operations
[AD-A230983] N91-21178
Construction site Voice Operated Information System (VOIS) test
[AD-A231633] N91-21424
Top quality management, reliability, and maintainability: Institutional goals with built in barriers
[AD-A230134] N91-21552
Software development standards for project cost management information system
[AD-A231282] N91-21762
QUANTITATIVE ANALYSIS
Analytical chemistry laboratory
[DE91-008986] N91-21266
QUANTUM CHEMISTRY
Theoretical study of the radiative lifetime for the spin-forbidden transition a3 (sigma u +) to X1 (sigma g +) in He2
[AD-A230956] N91-21854
QUANTUM CHROMODYNAMICS
Theoretical studies in elementary particle physics
[DE91-009543] N91-21851
QUANTUM EFFICIENCY
High current photoemission with 10 picosecond UV pulses
[DE91-009439] N91-21515
QUANTUM ELECTRODYNAMICS
On the temperature corrections for QED operators in the superstrong magnetic field
[DE91-619627] N91-21822
QUANTUM ELECTRONICS
Theory of the electronic and optical properties of semiconductor heterostructures
[AD-A231438] N91-21929
QUANTUM MECHANICS
Hamilton mechanics for nonlocal systems
[DE91-619625] N91-21936
QUANTUM THEORY
Can non-Gaussian fluctuations for structure formation arise from inflation
[DE91-009458] N91-21655
Transport via moments of quantum distribution functions
[AD-A231182] N91-21821
Hamilton mechanics for nonlocal systems
[DE91-619625] N91-21936
Quantization of nonlocal theories and gravitation
[DE91-619626] N91-21937
QUANTUM WELLS
Optical NIPI device characterization
[AD-A231157] N91-21922
Theory of the electronic and optical properties of semiconductor heterostructures
[AD-A231438] N91-21929
Kinetic aspects of lattice mismatch in molecular beam epitaxial growth on planar and patterned substrates
[AD-A231636] N91-21934
Requirements for SIS receivers in the 500-1000 GHz region N91-22015
QUARKS
Review of CERN heavy-ion physics
[DE91-009326] N91-21844
QUARTZ CRYSTALS
Quartz crystal resonators and oscillators for frequency control and timing applications: A tutorial, revision 4
[AD-A231604] N91-21445
QUASARS
Submillimeter observations of extragalactic objects in the wavelength range 50 microns to 1 mm N91-21994
The importance of submillimetre observations of radio quiet and radio loud AGN's N91-22000
QUERY LANGUAGES
AiGERM: A logic programming front end for GERM N91-21957
QUEUEING THEORY
Analysis of exhaustive limited service for token ring networks
[NASA-CR-188092] N91-21790
Queueing models for token and slotted ring networks
[NASA-CR-188091] N91-21791

R

RADAR
Experiment on rapidly intensifying cyclones over the Atlantic
[AD-A231377] N91-21682
RADAR ANTENNAS
Specification for a standard radar sea clutter model
[AD-A230848] N91-21409
RADAR CROSS SECTIONS
Analysis and testing of a bistatic radar cross section measurement capability for the AFIT anechoic chamber
[AD-A230609] N91-21401
RADAR DETECTION
UHF model simulation of detecting voids in a dielectric medium using HF-VHF airborne short-pulse radar
[AD-A231495] N91-21418
RADAR EQUIPMENT
UHF model simulation of detecting voids in a dielectric medium using HF-VHF airborne short-pulse radar
[AD-A231495] N91-21418
RADAR IMAGERY
A system for the real-time display of radar and video images of targets
[NASA-CR-188058] N91-21394
RADAR MEASUREMENT
Analysis and testing of a bistatic radar cross section measurement capability for the AFIT anechoic chamber
[AD-A230609] N91-21401
Transitive, anti-symmetric relational attributes in structural description matching with applications to radar target identification
[AD-A231318] N91-21417
RADAR SCATTERING
Analysis and testing of a bistatic radar cross section measurement capability for the AFIT anechoic chamber
[AD-A230609] N91-21401
RADAR TARGETS
Analysis and testing of a bistatic radar cross section measurement capability for the AFIT anechoic chamber
[AD-A230609] N91-21401
Transitive, anti-symmetric relational attributes in structural description matching with applications to radar target identification
[AD-A231318] N91-21417
RADAR TRANSMISSION
Radar signal categorization using a neural network N91-21782
RADIAL VELOCITY
Estimations of ABL fluxes and other turbulence parameters from Doppler lidar data
[NASA-CR-188062] N91-21648
RADIANT COOLING
Cooling of in-situ propellant rocket engines for Mars mission
[NASA-TM-103729] N91-21233
RADIANT FLUX DENSITY
Radiation dose calculations with the Monte Carlo method
[DE91-008582] N91-21841
RADIATION ABSORPTION
Study of relativistic electrons at channeling in a beryllium thick crystals
[DE91-619859] N91-21909
Observation of spectral diffusion in crystals using single impurity molecules
[AD-A231338] N91-21926
RADIATION DAMAGE
Atomic oxygen degradation of Intelsat 4-type solar array interconnects: Laboratory investigations
[NASA-TM-102175] N91-21286
Specificity of mutation induced by ionizing radiation and oxidizing free radicals
[DE91-008838] N91-21702
RADIATION DETECTORS
Nuclear radiation detectors
[INPE-5090-MD/44] N91-21847
Coherent and incoherent detection N91-22010
RADIATION DISTRIBUTION
Radiation dose calculations with the Monte Carlo method
[DE91-008582] N91-21841
RADIATION DOSAGE
Radiation dose calculations with the Monte Carlo method
[DE91-008582] N91-21841
Proton depth dose distribution: 3-D calculation of dose distributions from solar flare irradiation
[AD-A231230] N91-22061
RADIATION EFFECTS
Space vehicle propulsion systems: Environmental space hazards
[NASA-CR-188094] N91-21236
UV cured epoxy resin coatings
[DE91-008180] N91-21303
A center for the study of early events in photosynthesis
[DE91-006509] N91-21698
Specificity of mutation induced by ionizing radiation and oxidizing free radicals
[DE91-008838] N91-21702
Radiation health research, 1986 - 1990
[NASA-TM-4270] N91-21704
International document on food irradiation
[DE91-615879] N91-21715
Proton depth dose distribution: 3-D calculation of dose distributions from solar flare irradiation
[AD-A231230] N91-22061
RADIATION HAZARDS
The physiological effects of 50/60 Hz electromagnetic fields: Standards and guidelines
[DE91-752996] N91-21705
RADIATION PROTECTION
The physiological effects of 50/60 Hz electromagnetic fields: Standards and guidelines
[DE91-752996] N91-21705
RADIATION SOURCES
Effects of source correlations on the spectrum of radiated fields
[AD-A230955] N91-21411
Theoretical studies in elementary particle physics
[DE91-009543] N91-21851
RADIATION SPECTRA
Theoretical study of the radiative lifetime for the spin-forbidden transition a3 (sigma u +) to X1 (sigma g +) in He2
[AD-A230956] N91-21854
Advanced, time-resolved imaging techniques for electron-beam characterizations
[DE91-008587] N91-21865
LDR: A submillimeter great observatory N91-22018
The OASI observatory in Antarctica N91-22036
RADIATIVE LIFETIME
Theoretical study of the radiative lifetime for the spin-forbidden transition a3 (sigma u +) to X1 (sigma g +) in He2
[AD-A230956] N91-21854
RADIATIVE TRANSFER
Laboratory evaluation and application of microwave absorption properties under simulated conditions for planetary atmospheres
[NASA-CR-188096] N91-22057
RADIO ANTENNAS
Development of components for submillimeter wave heterodyne radiometers at JPL N91-22017
RADIO ASTRONOMY
Submillimeter astronomy and cosmological tests N91-21993
A flexible hybrid spectrometer for balloon borne and ground based (sub)millimeter wavelength astronomy N91-22043
The University of Tokyo-Norbeyama Radio Observatory submillimeter survey telescope N91-22051
RADIO COMMUNICATION
ELF communications system, ecological monitoring program: Summary of 1989 progress
[AD-A231497] N91-21419
RADIO EQUIPMENT
Definition of the concept of an interferometric spectrum analyzer for the detection of frequency hopping radios
[AD-A231031] N91-21413
RADIO FREQUENCIES
GaAs monolithic RF modules for SARSAT distress beacons
[NASA-TM-104338] N91-21184
Comparison of 14 decibels versus 20 decibels desired to undesired signal protection ratios
[DOT/FAA/CT-TN89/69] N91-21833

Advanced, time-resolved imaging techniques for electron-beam characterizations
[DE91-008587] N91-21865
Fiber optic sensing system
[NASA-CASE-LEW-14795-1] N91-21871

RADIO FREQUENCY HEATING
High-temperature metal purification using a compact, portable rf heating and levitation system on the wake shield N91-21363
Compact rf heating and levitation systems for the NASA modular electromagnetic levitator N91-21364
High temperature metal purification using a compact portable rf heating and levitation system on the wake shield N91-21365

RADIO GALAXIES
The importance of submillimetre observations of radio quiet and radio loud AGN's N91-22000
NGC3309: An S-shaped radio galaxy in a nearby cluster
[INPE-5143-PRE/1631] N91-22054

RADIO OCCULTATION
Laboratory evaluation and application of microwave absorption properties under simulated conditions for planetary atmospheres
[NASA-CR-188096] N91-22057

RADIO RECEIVERS
Requirements for SIS receivers in the 500-1000 GHz region N91-22015
Development of components for submillimeter wave heterodyne radiometers at JPL N91-22017

RADIO SIGNALS
Comparison of 14 decibels versus 20 decibels desired to undesired signal protection ratios
[DOT/FAA/CT-TN89/69] N91-21833

RADIO SOURCES (ASTRONOMY)
Millimeter observations of a complete sample of galaxies: Implications for gas mass and cold dust component N91-21999

RADIO TELESCOPES
The Smithsonian Astrophysical Observatory submillimeter wave telescope array N91-22009

RADIO TRANSMISSION
Long-term performance and propagation measurements on single and tandem digital microwave transmission links. Volume 1: Analysis of measurement data
[PB91-129643] N91-21396
Long-term performance and propagation measurements on single and tandem digital microwave transmission links. Volume 2: Appendixes
[PB91-129650] N91-21397
Radio wave propagation modeling, prediction and assessment
[AGARD-AG-326] N91-21404
Using the USU ionospheric model to predict radio propagation through a simulated ionosphere
[AD-A231599] N91-21423

RADIO WAVES
Radio wave propagation modeling, prediction and assessment
[AGARD-AG-326] N91-21404

RADIOACTIVE DECAY
Radiation dose calculations with the Monte Carlo method
[DE91-008582] N91-21841

RADIOGRAPHY
Radiographic instrumentation for DPM experiments N91-21373

RADIOISOTOPE BATTERIES
Post-encapsulation plutonia reduction for Galileo and Ulysses GPHS modules: The Module Reduction and Monitoring Facility (MRMF)
[DE91-008131] N91-21861

RADIOLOGY
Beam line and associated work
[AD-A231243] N91-21867

RADIOMETERS
AEDC focal plane array test capability
[AD-A230846] N91-21408
Production of image proportions through a linear mixing model
[INPE-5170-PRE/1639] N91-21615
RELICT 2 project: Scientific program and structure N91-21998
Development of components for submillimeter wave heterodyne radiometers at JPL N91-22017

RADIOSONDES
Calibration transfer target for a microwave radiometric profiling system
[PB91-129080] N91-21647

RAIL TRANSPORTATION
Determination of the flight hardware configuration of an energy absorbing attenuator for the proposed Space Station crew and equipment translation aid cart
[NASA-TP-3084] N91-21556
Effectiveness of bomber deployed autonomous airborne vehicles in finding rail mobile SS-24s
[DE91-009008] N91-21815

RAIN
Field intercomparison of precipitation samplers for assessing wet deposition of organic contaminants
[PB91-125880] N91-21629
Dynamics of vegetation and soils of oak/saw palmetto scrub after fire: Observations from permanent transects
[NASA-TM-103817] N91-21635

RAINBOWS
Optical scattering methods applicable to drops and bubbles N91-21358

RAMAN SPECTRA
Artifact diamond characterization
[AD-A231555] N91-21323

RAMAN SPECTROSCOPY
Nonlinear optical spectroscopy of Ce3(+) ions in insulating crystals
[DE91-008928] N91-21913

RANDOM PROCESSES
Chaotic and random processes
[DE91-008574] N91-21804

RANDOM SIGNALS
Chaotic and random processes
[DE91-008574] N91-21804

RANDOM VIBRATION
Experimental laboratory system to generate high frequency test environments
[DE91-008252] N91-21583
Chaotic and random processes
[DE91-008574] N91-21804

RANDOM WALK
Identification of parameters derived from inertial sensors
[INPE-5166-RPE/637] N91-21746

RANGEFINDING
The gravitomagnetic interaction and its relationship to other relativistic gravitational effects
[NASA-CR-187736] N91-21649

RARE EARTH ALLOYS
Double 4f-collapse in Ce(0.9-x)Yb(x)Th(0.1)
[DE91-619752] N91-21908

RATES (PER TIME)
Navigation Experiment NAVEX: Measurement and performance of the spaceborne clocks
[ESA-TT-1209] N91-21823

RATIONAL FUNCTIONS
Optimal Hankel-norm approximation and rational function models using impulse response data
[AD-A231317] N91-21839

RAY TRACING
Using the USU ionospheric model to predict radio propagation through a simulated ionosphere
[AD-A231599] N91-21423

RAYLEIGH-BENARD CONVECTION
Probability distribution functions in turbulent convection
[NASA-CR-187519] N91-21453

RAYLEIGH-RITZ METHOD
Variational method in the statistical theory of turbulence
[AD-A231621] N91-21484
Thermal buckling and postbuckling of symmetrically laminated composite plates
[NASA-CR-188030] N91-21560

REACTION KINETICS
Laser probes of natural gas ignition chemistry
[PB91-127993] N91-21262
Simulation of chemical kinetics in combustion
[DE91-008446] N91-21273
Scanning tunneling microscopy of reactive sites: Gasification of graphite by oxygen and hydrogen
[DE91-008569] N91-21274
High octane ethers from synthesis gas-derived alcohol
[DE91-008367] N91-21325
Containerless processing of undercooled melts N91-21339
Construction of flowing afterglow apparatus
[AD-A231062] N91-21855
Characteristic x rays method for detecting cold fusion
[DE91-619982] N91-21890

REACTIVITY
Scanning tunneling microscopy of reactive sites: Gasification of graphite by oxygen and hydrogen
[DE91-008569] N91-21274
Theoretical investigation leading to energy storage in atomic and molecular systems
[AD-A231275] N91-21858

REACTOR TECHNOLOGY
High performance H modes in JET
[DE91-005488] N91-21883

REAL TIME OPERATION
Evaluation of air injection in a sudden expansion diffuser for real-time afterburning application
[AD-A230850] N91-21141
Fully automatic guidance and control for rotorcraft nap-of-the-Earth flight following planned profiles. Volume 1: Real-time piloted simulation
[NASA-CR-177571-VOL-1] N91-21149
Fully automatic guidance and control for rotorcraft nap-of-the-Earth flight following planned profiles. Volume 2: Mathematical model
[NASA-CR-177571-VOL-2] N91-21150
Real time assisted tracking for low Earth orbit satellites
[INPE-5157-PRE/1636] N91-21170
The spacecraft control laboratory experiment optical attitude measurement system
[NASA-TM-102624] N91-21186
Real-time measurement of materials properties at high temperatures by laser produced plasmas N91-21342
A system for the real-time display of radar and video images of targets
[NASA-CR-188058] N91-21394
Determining concurrency in object-oriented design of real-time embedded systems using Ada
[AD-A230659] N91-21738
Single board system for fuzzy inference N91-21784
XTP for the NASA space station
[NASA-CR-188087] N91-21966

REATTACHED FLOW
Method and apparatus for detecting laminar flow separation and reattachment
[NASA-CASE-LAR-13952-2-SB] N91-21472

RECEIVERS
Holographic lens for wide field-of-view laser communication receiver
[AD-A231620] N91-21502

RECOGNITION
Cloud classification of DMSP visible and IR imagery using physical and textural features
[AD-A231186] N91-21680

RECOMBINATION REACTIONS
Time-resolved extreme-ultraviolet spectroscopy of laser-produced plasmas originating at the parylene layer of microballon targets
[DE91-009378] N91-21900

RECONNAISSANCE AIRCRAFT
Embedded computers: Navy's approach to developing patrol aircraft avionics system too risky
[AD-A230868] N91-21136

RECORDING INSTRUMENTS
Magnetic bearings for a spaceflight optical disk recorder N91-21195

RECTANGULAR WINGS
Velocity measurements in a turbulent trailing vortex and their application to BWI noise prediction
[NASA-CR-188083] N91-21100

RECTIFIERS
High reliability megawatt transformer/rectifier
[NASA-CR-187079] N91-21430

REDUCED GRAVITY
Fire suppression in human-crew spacecraft
[NASA-TM-104334] N91-21182
Aerospace Applications of Magnetic Suspension Technology, part 1
[NASA-CP-10066-PT-1] N91-21188
Control issues of microgravity vibration isolation N91-21192
Microgravity vibration isolation: An optimal control law for the one-dimensional case N91-21206
Proceedings of the First Workshop on Containerless Experimentation in Microgravity
[NASA-CR-187806] N91-21331
Charge of the containerless experimentation in microgravity N91-21332
Ground-based and microgravity containerless positioning technologies and facilities N91-21333
Very high temperature chemistry: Science justification for containerless experimentation in space N91-21334
NASA-sponsored containerless processing experiments N91-21335
Containerless processing projects N91-21336
Containerless processing in the European microgravity programme N91-21337
The Japanese containerless experiments N91-21338
Containerless processing of undercooled melts N91-21339
Containerless synthesis of interesting glasses N91-21340
Containerless experiments in fluid physics in microgravity N91-21341
Real-time measurement of materials properties at high temperatures by laser produced plasmas N91-21342
A dynamic technique for measuring surface tension at high temperatures in microgravity environment N91-21347
Experiments for electromagnetic levitation in microgravity N91-21348
Supercritical microgravity droplet vaporization N91-21354

Using a microgravity environment to probe wave turbulence N91-21355
Drop evaporation in a single-axis acoustic levitator N91-21356
Containerless processing of amorphous ceramics N91-21367
An examination of anticipated g-jitter on space station and its effects on materials processes [NASA-TM-103775] N91-21378
Center for low-gravity fluid mechanics and transport phenomena [NASA-CR-188048] N91-21452
Spiral vane bioreactor [NASA-CASE-MSC-21361-1] N91-21701
Radiation health research, 1986 - 1990 [NASA-TM-4270] N91-21704

REENTRY PHYSICS
Norwegian studies of plasma modifications around spacecraft and how these affect the vehicle potential N91-21166

REFLECTANCE
Ex-situ and in-situ ellipsometric studies of the thermal oxide on InP [AD-A231095] N91-21283
Kalman filter tracking of a reflective target using forward looking infrared measurements and laser illumination [AD-A231196] N91-21524
Production of image proportions through a linear mixing model [INPE-5170-PRE/1639] N91-21615
New materials and new techniques for imaging of long wavelength IR radiation [AD-A231086] N91-21877

REFLECTING TELESCOPES
Telescope technology for space-borne submillimeter astronomy N91-22049

REFLECTOR ANTENNAS
A new fabrication method for precision antenna reflectors for space flight and ground test [NASA-TP-3078] N91-21185

REFLECTORS
A new fabrication method for precision antenna reflectors for space flight and ground test [NASA-TP-3078] N91-21185
The Submillimeter Telescope (SMT) N91-22033

REFORESTATION
Experiences in assessing changes in the use of savanna ecosystems [INPE-5187-PRE/1655] N91-21605

REFRACTIVITY
Observation of the photorefractive effect in a polymer [AD-A231339] N91-21322

REFRIGERATORS
Development of a low noise 10 KJ-T refrigeration system [AD-A231383] N91-21392
Development of a low noise 10K J-T refrigeration system [AD-A231461] N91-21393

REGULATIONS
Science, medicine and animals [ISBN-0-309-04439-1] N91-21697
Unified agenda of Federal regulations, October 1990 [PB91-120527] N91-21984

REINFORCING FIBERS
Mechanical behavior of fiber reinforced SiC/RBSN ceramic matrix composites: Theory and experiment [NASA-TM-103688] N91-21243

RELATIVISTIC EFFECTS
The gravitomagnetic interaction and its relationship to other relativistic gravitational effects [NASA-CR-187736] N91-21649
Stabilities of regular motion in the relativistic standard map [NIFS-73] N91-21894

RELATIVISTIC PARTICLES
Study of relativistic electrons at channeling in a beryllium thick crystals [DE91-619859] N91-21909

RELATIVITY
The gravitomagnetic interaction and its relationship to other relativistic gravitational effects [NASA-CR-187736] N91-21649
Studies of synchrotron radiation emission from the NRL modified betatron accelerator [AD-A231346] N91-21868

RELAXATION METHOD (MATHEMATICS)
A monotone decreasing algorithm for the 0-1 multiknapsack dual problem [INPE-5160-RPE/635] N91-21745
Normalized convergence rates for the PSMG method [AD-A231311] N91-21764

RELIABILITY
High reliability megawatt transformer/rectifier [NASA-CR-187079] N91-21430

RELIABILITY ANALYSIS
Modeling failure and reliability in new-generation devices [AD-A230998] N91-21439

RELIC RADIATION
RELICT 2 project: Scientific program and structure N91-21998

REMOTE CONTROL
A remote visual interface tool for simulation control and display [AD-A231019] N91-21754

REMOTE SENSING
AVHRR/NOAA imagery navigation from the geodetic reference matrix: Studies and evaluations [INPE-5216-PRE/1672] N91-21126
Survey of NCAR user needs for visualization tools. A research report of the Digital/NCAR joint research project [PB91-115444] N91-21154
Proposed methodology for the study of urban environment and space structure in metropolitan area [INPE-5203-PRE/1665] N91-21216
Remote sensing estimation of total chlorophyll pigment distribution in Barra Bonita Reservoir [INPE-5202-PRE/1664] N91-21603
Experiences in assessing changes in the use of savanna ecosystems [INPE-5187-PRE/1655] N91-21605
Discrimination of lithological units in the lower Valley of the Curaca River (Bahia), through enhancement of digital processing of MSS-LANDSAT-3 data [INPE-5120-RPE/627] N91-21613
Data integration of different sensor systems through the technique of IHS transformation, the purpose and study of intra-urban structure [INPE-5171-PRE/1640] N91-21616
A digital data bank for geological exploration in the mining belt of the Pojuca (Carajas) Cu-Zn deposit, based on geological, geochemical, remote sensing, and elevation data [INPE-5172-PRE/1641] N91-21617
Correlative studies between spectral responses and weathering indices of alternate weathered cover [INPE-5176-PRE/1645] N91-21618
Spectral characteristics of agricultural crops and yield [INPE-5125-RPE/630] N91-21619
Design and development of the terrain information extraction system [AD-A231166] N91-21623
Polar research from satellites [NASA-CR-188025] N91-21640
Volcanic aerosols: Chemistry, evolution, and effects N91-21645
Estimations of ABL fluxes and other turbulence parameters from Doppler lidar data [NASA-CR-188053] N91-21665
Case study analysis of clustering applied to VAS measurements [PB91-127829] N91-21666
Interaction of surface waves and near surface currents [AD-A231612] N91-21694
Scan-line methods in spatial data systems [AD-A231165] N91-21973

REMOTE SENSORS
The oceanic cloudy atmosphere: Measurement requirements and solution options [AD-A231121] N91-21677

REPORTS
Transportation telecommunications [PB91-123257] N91-21399

REQUIREMENTS
Impact of icing on Unmanned Aerial Vehicle (UAV) operations [AD-A231191] N91-21124
Requirements and trade-off studies in satellite mechanical architecture [INPE-5186-PRE/1654] N91-21219
Methodology development for the verification and validation of flight critical systems software, phase 1 [AD-A229932] N91-21735

RESEARCH AIRCRAFT
Identification of the aerodynamic model of the DLR research aircraft ATTAS from flight test data [DLR-FB-90-40] N91-21130

RESEARCH AND DEVELOPMENT
From Earth to space and back: Selected papers on Norwegian space activities [NSC-REPT(90)2] N91-21159
Development of Norwegian space activities N91-21160
Offshore technology R and D in space applications N91-21162
Space research in Norway N91-21167
Transportation telecommunications [PB91-123257] N91-21399
Science, medicine and animals [ISBN-0-309-04439-1] N91-21697
The 1991/92 graduate student researchers program, including the underrepresented minority focus component [NASA-TM-101801] N91-22065

RESEARCH FACILITIES
Identification of information needs in a research institute [INPE-5154-TDL/425] N91-21967
NASA Ames aerospace systems directorate research [NASA-TM-103844] N91-22066

RESEARCH PROJECTS
Analytical chemistry laboratory [DE91-008986] N91-21266
Polar research from satellites [NASA-CR-188025] N91-21640
FWP executive summaries: Basic energy sciences, materials sciences programs [DE91-009223] N91-21826
FY 1989 acoustics research [AD-A231499] N91-21840

RESERVOIRS
Remote sensing estimation of total chlorophyll pigment distribution in Barra Bonita Reservoir [INPE-5202-PRE/1664] N91-21603
Temporal variation of areas occupied by aquatic macrophytes in the Tucurui reservoir through Landsat/TM data [INPE-5174-PRE/1643] N91-21607

RESIDUAL STRESS
Measurement of residual stresses by x ray diffraction near simulated heat affected zones in austenitic stainless steels [DE91-008874] N91-21289
Materials can be stressed out too [AD-A231351] N91-21589

RESINS
An evaluation of the effects of varying composition and processing on several encapsulating resins [DE91-009101] N91-21314

RESONANCE
Study of the absorption lines widened by the effect of pressure, emitted by the combustion gases of propulsive powders [ISL-R-124/89] N91-21237
Scattering in the time domain from submerged elastic shells at coincidence frequencies [AD-A231122] N91-21837
Diffusive transport enhancement by isolated resonances and distribution tails growth in hadronic beams [DE91-006379] N91-21864

RESONANCE SCATTERING
Scattering in the time domain from submerged elastic shells at coincidence frequencies [AD-A231122] N91-21837

RESONATORS
Quartz crystal resonators and oscillators for frequency control and timing applications: A tutorial, revision 4 [AD-A231604] N91-21445

RESOURCES MANAGEMENT
Bibliography on the international network of biosphere reserves [PB90-215518] N91-21600

RESPIRATION
Inhalation toxicology. 11: The effect of elevated temperature on carbon monoxide toxicity [AD-A231185] N91-21708

RESPONSES
Optimal Hankel-norm approximation and rational function models using impulse response data [AD-A231317] N91-21839

RESTORATION
Introduction to digital imagery processing [INPE-5212-MD/46] N91-21612

REVERSE FIELD PINCH
Kinetic stability of field-reversed configurations [DE91-009530] N91-21901

REYNOLDS STRESS
Turbulent separated flow past a backward-facing step: A critical evaluation of two-equation turbulence models [NASA-CR-187532] N91-21451
Characteristic eddy decomposition of turbulence in a channel [NASA-TM-100065] N91-21470

RHEOLOGY
Basic rheology and its application to nitrocellulose propellant processing by screw mix-extruders [AD-A230872] N91-21326
Rheological properties, shape oscillations, and coalescence of liquid drops with surfactants N91-21357
Report of the panel on earth structure and dynamics, section 6 N91-21595

RICCATI EQUATION
Closed-form solutions for linear regulator design of mechanical systems including optimal weighting matrix selection
[NASA-TM-104052] N91-21572
RIGID STRUCTURES
A plane-sweep algorithm for exact simulation of a quasi-static mechanical system of compliantly-connected rigid bodies (extended abstract)
[AD-A231324] N91-21550
A method for the geometrically nonlinear analysis of compressively loaded prismatic composite structures
[NASA-CR-184846] N91-21561
RIMS
Analysis of rolling contact spall life in 440 C steel bearing rims
[NASA-CR-184101] N91-21526
RISK
Impact of icing on Unmanned Aerial Vehicle (UAV) operations
[AD-A231191] N91-21124
Evaluation of indigenous areas utilizing TM/LANDSAT data
[INPE-5173-PRE/1642] N91-21636
Radiation health research, 1986 - 1990
[NASA-TM-4270] N91-21704
An introduction to financial and economic analysis: Power projects in industrializing and non-industrialized countries
[DE91-752995] N91-21976
RIVERS
Characterization of antropic action in the Mearim (MA) middle-low valley through LANDSAT/TM imagery
[INPE-5075-PRE/1594] N91-21620
ROBOT ARMS
Control of free-flying space robot manipulator systems
[NASA-CR-188026] N91-21527
Method and apparatus for positioning a robotic end effector
[NASA-CASE-MSC-21476-1] N91-21542
Method and apparatus for configuration control of redundant robots
[NASA-CASE-NPO-17801-1-CU] N91-21544
Studies of a direct drive robot with a parallel configuration
[AD-A231265] N91-21548
ROBOT CONTROL
Control of free-flying space robot manipulator systems
[NASA-CR-188026] N91-21527
Experiments in thrusterless robot locomotion control for space applications
[NASA-CR-188027] N91-21528
Method and apparatus for positioning a robotic end effector
[NASA-CASE-MSC-21476-1] N91-21542
Studies of a direct drive robot with a parallel configuration
[AD-A231265] N91-21548
ROBOT DYNAMICS
Control of free-flying space robot manipulator systems
[NASA-CR-188026] N91-21527
Experiments in thrusterless robot locomotion control for space applications
[NASA-CR-188027] N91-21528
Experiments in cooperative-arm object manipulation with a two-armed free-flying robot
[NASA-CR-188028] N91-21529
Method and apparatus for configuration control of redundant robots
[NASA-CASE-NPO-17801-1-CU] N91-21544
Generalizing the hop: Object-level programming for legged motion
[AD-A231315] N91-21549
ROBOT SENSORS
Method and apparatus for positioning a robotic end effector
[NASA-CASE-MSC-21476-1] N91-21542
ROBOTICS
First Annual Meeting of International Neural Network Society
[AD-A230283] N91-21777
Neural network representation and learning of mappings and their derivatives N91-21780
ROBOTS
Experiments in cooperative-arm object manipulation with a two-armed free-flying robot
[NASA-CR-188028] N91-21529
Method and apparatus for configuration control of redundant robots
[NASA-CASE-NPO-17801-1-CU] N91-21544
ROBUSTNESS (MATHEMATICS)
Integrated flight/propulsion control design for a STOVL aircraft using H-infinity control design techniques
[NASA-TM-104340] N91-21140
A linear quadratic regulator weight selection algorithm for robust pole assignment
[AD-A230598] N91-21737
ROCKET ENGINE DESIGN
Advanced expander test bed program
[NASA-CR-187082] N91-21234
Heavy hydrocarbon main injector technology program
[NASA-CR-188082] N91-21235
ROCKET ENGINES
Cooling of in-situ propellant rocket engines for Mars mission
[NASA-TM-103729] N91-21233
Space vehicle propulsion systems: Environmental space hazards
[NASA-CR-188094] N91-21236
ROCKET LAUNCHING
Kauai Test Facility two experiment rocket campaign
[DE91-008894] N91-21172
ROCKET NOZZLES
Boundary layer study. Phase 4: Experimental validation test plan
[AD-A231342] N91-21481
Boundary layer study
[AD-A231343] N91-21482
ROCKET OXIDIZERS
Elastomer compatibility with liquid propellant at elevated temperature
[AD-A230973] N91-21327
ROCKET PROPELLANTS
The energy source rocket of the Soviet Union
[AD-A224938] N91-21229
Cooling of in-situ propellant rocket engines for Mars mission
[NASA-TM-103729] N91-21233
Theoretical investigation of energy storage in atomic and molecular systems: Metastable molecular fuels
[AD-A230854] N91-21852
ROCKETS
Model rocketry hazard study
[DOT/FAA/CT-TN90/28] N91-21238
RODS
A comparison of calculational results with experimental data for long rod projectiles
[DE91-009006] N91-21536
ROLL
Determination of pitch and roll angles with respect to a point on earth surface
[INPE-5206-PRE/1668] N91-21215
ROLLER BEARINGS
Modeling of rolling element bearing mechanics
[NASA-CR-188045] N91-21530
ROLLERS
Fully articulated four-point-bend loading fixture
[NASA-CASE-LEW-14776-1] N91-21540
ROLLING MOMENTS
Lift and rolling moment due to spoilers on wings at subsonic speeds
[ESDU-90030] N91-21129
ROTARY WING AIRCRAFT
Evaluation of an alternative rotorcraft cargo lowering device for the delivery of 500-lb ammunition loads
[AD-A230995] N91-21133
Fully automatic guidance and control for rotorcraft nap-of-the-Earth flight following planned profiles. Volume 1: Real-time piloted simulation
[NASA-CR-177571-VOL-1] N91-21149
Fully automatic guidance and control for rotorcraft nap-of-the-Earth flight following planned profiles. Volume 2: Mathematical model
[NASA-CR-177571-VOL-2] N91-21150
Advanced rotorcraft transmission program
[NASA-TM-103276] N91-21531
ROTARY WINGS
Flow visualization ion helicopter blades using Acenaphthen
[DLR-FB-90-37] N91-21466
A study of rotor broadband noise mechanisms and helicopter tail rotor noise
[NASA-CR-177565] N91-21829
ROTATING BODIES
Orbital debris sweeper and method
[NASA-CASE-MSC-21534-1] N91-21222
ROTATING PLASMAS
Role of the edge electric field and microturbulence in the L-H transition
[DE91-008925] N91-21888
ROTATING STALLS
An experimental study of exit flow patterns in a multistage compressor in rotating stall
[AD-A231353] N91-21143
ROTATION
Coning motion of slender bodies at high angles of attack
[NAL-TR-1059] N91-21111
An experimental study of exit flow patterns in a multistage compressor in rotating stall
[AD-A231353] N91-21143
Rotary-balance testing for aircraft dynamics
[AGARD-AR-265] N91-21156
Improved fits for the vibrational and rotational constants of many states of nitrogen and oxygen
[AD-A229996] N91-21263
Dynamics of rotating flexible structures by a method of quadratic modes
[DE91-009224] N91-21565
Proton depth dose distribution: 3-D calculation of dose distributions from solar flare irradiation
[AD-A231230] N91-22061
ROTOR AERODYNAMICS
A study of rotor broadband noise mechanisms and helicopter tail rotor noise
[NASA-CR-177565] N91-21829
ROTOR BLADES (TURBOMACHINERY)
A modal aeroelastic analysis scheme for turbomachinery blading
[NASA-CR-187089] N91-21138
ROTOR DYNAMICS
Modeling of rolling element bearing mechanics
[NASA-CR-188045] N91-21530
ROTORS
Numerical solutions of 2-D multi-stage rotor/stator unsteady flow interactions N91-21070
Dynamic modelling and analysis of a magnetically suspended flexible rotor N91-21208
Critical speeds and forced response solutions for active magnetic bearing turbomachinery, part 1 N91-21209
Calculation of thickness and charge noise radiated by a rotor in forward flight
[ISL-R-119/89] N91-21831
ROUTES
Very high speed holographic message routing for parallel machines
[AD-A230965] N91-21499
RUBIDIUM
Navigation Experiment NAVEX: Measurement and performance of the spaceborne clocks
[ESA-TT-1209] N91-21823
RULES
Fuzzy associative memories N91-21779
RUN TIME (COMPUTERS)
AEOSS runtime manual for system analysis on Advanced Earth-Orbital Spacecraft Systems
[NASA-TM-100773] N91-21224
RUNGE-KUTTA METHOD
Distributed Minimal Residual (DMR) method for acceleration of iterative algorithms N91-21077
A multiblock multigrid three-dimensional Euler equation solver
[NASA-TM-103424] N91-21795
RUNWAY CONDITIONS
Frictional and retarding forces on aircraft tyres. Part 5: Estimation of fluid drag forces
[ESDU-90035] N91-21537
RUNWAYS
Non-airborne conflicts: The causes and effects of runway transgressions
[NASA-CR-177372] N91-21121
RUPTURING
Fully articulated four-point-bend loading fixture
[NASA-CASE-LEW-14776-1] N91-21540

S

S MATRIX THEORY
Hamilton mechanics for nonlocal systems
[DE91-619625] N91-21936
Quantization of nonlocal theories and gravitation
[DE91-619626] N91-21937
S WAVES
Research in nonlinear water waves
[AD-A231205] N91-21477
SALINITY
WINTER 1990 hydrographics data report: CTD station profiles, sections, nutrients, SAIL, January - February 1990
[DE91-008286] N91-21686
SAMPLERS
Field intercomparison of precipitation samplers for assessing wet deposition of organic contaminants
[PB91-125880] N91-21629
SAMPLING
High-pressure promoted combustion chamber
[NASA-CASE-MSC-21470-1] N91-21157
Sampling and characterization of aerosols
[LUNDD/TMAT-90/2002] N91-21269
Atmospheric methane data for the period 1986-1988 from the NOAA/CMDL global cooperative flask sampling network
[PB91-129122] N91-21626

Dynamics of vegetation and soils of oak/saw palmetto scrub after fire: Observations from permanent transects
[NASA-TM-103817] N91-21635
Intercomparison of the chemical and meteorological data generated from aircraft and shipboard sampling during GCE/CASE/WATOX
[PB91-129098] N91-21667

SARSAT
GaAs monolithic RF modules for SARSAT distress beacons
[NASA-TM-104338] N91-21184

SATELLITE ALTIMETRY
Satellite altimetry for naval oceanography
[AD-A231081] N91-21691
Objective use of satellite altimetry and IR in simulations of western boundary current dynamics
[AD-A231628] N91-21695

SATELLITE ANTENNAS
A new fabrication method for precision antenna reflectors for space flight and ground test
[NASA-TP-3078] N91-21185

SATELLITE CONFIGURATIONS
Requirements and trade-off studies in satellite mechanical architecture
[INPE-5186-PRE/1654] N91-21219

SATELLITE CONTROL
Attitude control simulation of the data collecting satellite: SCD2
[INPE-5159-PRE/1638] N91-21218

SATELLITE IMAGERY
AVHRR/NOAA imagery navigation from the geodetic reference matrix: Studies and evaluations
[INPE-5216-PRE/1672] N91-21126
Report of the panel on plate motion and deformation, section 2 N91-21591
Registration of windfall damage in the eastern Hunsrueck Plateau (Fed. Republic of Germany) utilizing LANDSAT TM data: A landscape-ecological analysis for practical forestry
[DLR-FB-90-31] N91-21601
Evaluation of TM/LANDSAT-5 bands in the discrimination of wheat and beam crops
[INPE-5204-PRE/1666] N91-21602
Verification of parameters and morphological-environmental properties, by satellite imagery, for studies of coastal region planning
[INPE-5177-PRE/1646] N91-21606
Temporal variation of areas occupied by aquatic macrophytes in the Tucurui reservoir through Landsat/TM data
[INPE-5174-PRE/1643] N91-21607
Spot 1: Imagery in geologic mapping: A comparative study with several remote sensing products in the Curaca River Valley, Bahia
[INPE-5136-PRE/1624] N91-21608
Use of direct expansion for estimation of soybean and corn areas through multispectral and temporal LANDSAT/TM data
[INPE-5180-PRE/1649] N91-21609
Volcanic-sedimentary sequence of the Greenstone Belt type in the Santa Rita or Goias elevation: An approach with TM-Landsat data
[INPE-5178-PRE/1647] N91-21610
Comparative analysis of AVHRR/NOAA and TM/LANDSAT data in the delimitation of savanna/forest contact area: Preliminary results
[INPE-5200-RPE/639] N91-21611
Discrimination of lithological units in the lower Valley of the Curaca River (Bahia), through enhancement of digital processing of MSS-LANDSAT-3 data
[INPE-5120-RPE/627] N91-21613
Production of image proportions through a linear mixing model
[INPE-5170-PRE/1639] N91-21615
Data integration of different sensor systems through the technique of IHS transformation, the purpose and study of intra-urban structure
[INPE-5171-PRE/1640] N91-21616
A digital data bank for geological exploration in the mining belt of the Pojuca (Carajas) Cu-Zn deposit, based on geological, geochemical, remote sensing, and elevation data
[INPE-5172-PRE/1641] N91-21617
Correlative studies between spectral responses and weathering indices of alternate weathered cover
[INPE-5176-PRE/1645] N91-21618
Characterization of antropic action in the Mearim (MA) middle-low valley through LANDSAT/TM imagery
[INPE-5075-PRE/1594] N91-21620
On the response of the special sensor microwave/imager to the marine environment: Implications for atmospheric parameter retrievals
[NASA-CR-188032] N91-21664
Stratus surge prediction along the Central California coast
[PB91-129239] N91-21668
Satellite-derived moisture-bogusing profiles for the Northwest Pacific Ocean
[AD-A231058] N91-21690

SATELLITE INSTRUMENTS
Polar research from satellites
[NASA-CR-188025] N91-21640
The submillimeter wave astronomy satellite N91-22025
FIR and sub-mm direct detection spectrometers for spaceborne astronomy N91-22026

SATELLITE OBSERVATION
Polar research from satellites
[NASA-CR-188025] N91-21640
Tactical Environmental Support System (TESS(3)) satellite cloud analyses
[AD-A231247] N91-21681
Satellite altimetry for naval oceanography
[AD-A231081] N91-21691
Analysis and interpretation of diffuse x-ray emission using data from the Einstein satellite
[NASA-CR-187988] N91-21728

SATELLITE ORIENTATION
Determination of pitch and roll angles with respect to a point on earth surface
[INPE-5206-PRE/1668] N91-21215
Attitude control simulation of the data collecting satellite: SCD2
[INPE-5159-PRE/1638] N91-21218

SATELLITE PERTURBATION
A perturbation solution of the main problem in artificial satellite theory
[AD-A231560] N91-21227

SATELLITE ROTATION
Attitude control simulation of the data collecting satellite: SCD2
[INPE-5159-PRE/1638] N91-21218

SATELLITE SOUNDING
Case study analysis of clustering applied to VAS measurements
[PB91-127829] N91-21666

SATELLITE TRACKING
Real time assisted tracking for low Earth orbit satellites
[INPE-5157-PRE/1636] N91-21170

SATELLITE TRANSMISSION
Real time assisted tracking for low Earth orbit satellites
[INPE-5157-PRE/1636] N91-21170

SAWTOOTH WAVEFORMS
Sawteeth and their stabilization in JET
[DE91-005459] N91-21882
High performance H modes in JET
[DE91-005488] N91-21883

SCALARS
Implicit solution of three-dimensional internal turbulent flows N91-21082

SCALE MODELS
UHF model simulation of detecting voids in a dielectric medium using HF-VHF airborne short-pulse radar
[AD-A231495] N91-21418

SCANNERS
A high-speed spatial (linear) scanning pyrometer: A tool for diagnostics, temperature mapping, and property determinations at high temperatures N91-21361

SCANNING TUNNELING MICROSCOPY
Scanning tunneling microscopy of reactive sites: Gasification of graphite by oxygen and hydrogen
[DE91-008569] N91-21274

SCATTERING
Measurements of scattering processes in negative ion-atom collisions
[DE91-009514] N91-21849

SCHOTTKY DIODES
Laterally stacked Schottky diodes for infrared sensor applications
[NASA-CASE-NPO-17426-1-CU] N91-21434
Requirements for SIS receivers in the 500-1000 GHz region N91-22015

SCHROEDINGER EQUATION
Hamilton mechanics for nonlocal systems
[DE91-619625] N91-21936

SCIENTISTS
Improving risk communication through interactive training in communication skills
[DE91-008366] N91-21402

SCINTILLATION
Radio wave propagation modeling, prediction and assessment
[AGARD-AG-326] N91-21404

SCINTILLATION COUNTERS
Experimental response functions and response matrices for 2.54-cm x 2.54 cm and 7.62 cm x 7.62 cm bismuth germanate scintillation detectors
[AD-A230140] N91-21486
Cosmic Ray Nuclei (CRN) detector investigation
[NASA-CR-184137] N91-22063

SEA STATES
Specification for a standard radar sea clutter model
[AD-A230848] N91-21409
Statistical properties of the sea surface sound dipole source
[AD-A230811] N91-21688

SEA SURFACE TEMPERATURE
Global monthly sea surface temperature climatology
[PB91-129304] N91-21669

SEALING
O-ring gasket test fixture
[NASA-CASE-MFS-28376-1] N91-21175

SEAMS (JOINTS)
Resistance seam welding thin copper foils
[DE91-008988] N91-21535

SEAS
Dynamics of oceanic motions
[AD-A231135] N91-21693

SECONDARY EMISSION
In-situ diffraction and imaging studies of heteroepitaxial growth of semi-conductors
[AD-A231568] N91-21932

SECURITY
Promoting a healthy skepticism with regard to information processing
[DE91-007697] N91-21968

SEDIMENTARY ROCKS
Volcanic-sedimentary sequence of the Greenstone Belt type in the Santa Rita or Goias elevation: An approach with TM-Landsat data
[INPE-5178-PRE/1647] N91-21610

SEISMIC WAVES
Intelligent array system
[AD-A231107] N91-21792
Operation, maintenance, and research activities at NORSAR, NORESS, and ARCESS
[AD-A230874] N91-21970

SEISMOLOGY
Intelligent array system
[AD-A231107] N91-21792
National Geophysical Data Center: Programs and services (25th anniversary 1965-1990)
[PB91-123356] N91-21960
Operation, maintenance, and research activities at NORSAR, NORESS, and ARCESS
[AD-A230874] N91-21970

SELF ORGANIZING SYSTEMS
Computing with neural networks: A comparison of the multi-layer perceptron and the hierarchical pattern recognition network for classification problems
[AD-A231584] N91-21768
Self-organization and clustering algorithms N91-21783
Solution of inverse problem of fuzzy relational equation by using perceptron model N91-21786

SEMANTICS
An endorsement-based approach to student modeling for planner-controlled intelligent tutoring systems
[NASA-CR-188177] N91-21739
Implementation of a matrix theorem prover for propositional modal logic
[INPE-5124-RPE/629] N91-21743

SEMICONDUCTOR DEVICES
Computer aided design tools and algorithms for submicron technologies
[AD-A231171] N91-21757

SEMICONDUCTOR JUNCTIONS
Theory of the electronic and optical properties of semiconductor heterostructures
[AD-A231438] N91-21929

SEMICONDUCTOR LASERS
High efficiency surface-emitting semiconductor laser resonators
[DE91-005236] N91-21510
Theory of semiconductor laser feedback instability
[DE91-008198] N91-21512
Fiber optic sensing system
[NASA-CASE-LEW-14795-1] N91-21871

SEMICONDUCTORS (MATERIALS)
FWP executive summaries: Basic energy sciences, materials sciences programs
[DE91-009223] N91-21826
Pressure dependence of deep centers by capacitance spectroscopies inside the diamond anvil cell
[DE91-008927] N91-21906
Monolithic integration of semiconductor and superconductor components
[AD-A231464] N91-21930
The necessity for a DOD capability in superconducting electronics
[AD-A231553] N91-21931
In-situ diffraction and imaging studies of heteroepitaxial growth of semi-conductors
[AD-A231568] N91-21932

SENSITIVITY
Deterministic and stochastic sensitivity in computational structural mechanics
[ISSN-0208-5658] N91-21571
A discourse on sensitivity analysis for discretely-modeled structures
[NASA-TM-104065] N91-21577
The confusion limits to the sensitivity of submillimeter telescopes N91-22001
Coherent and incoherent detection N91-22010
SEPARATED FLOW
Computation of laminar viscous-inviscid interactions in high-speed internal flows N91-21087
Turbulent separated flow past a backward-facing step: A critical evaluation of two-equation turbulence models
[NASA-CR-187532] N91-21451
Method and apparatus for detecting laminar flow separation and reattachment
[NASA-CASE-LAR-13952-2-SB] N91-21472
SEQUENCING
An automatic parallelization tool for sequential programs
[AD-A229972] N91-21771
SERIES EXPANSION
A perturbation solution of the main problem in artificial satellite theory
[AD-A231560] N91-21227
SERVOMOTORS
Magnetic bearings for a spaceflight optical disk recorder N91-21195
SET THEORY
Interior-point methods for convex programming
[AD-A231372] N91-21765
Fuzzy associative memories N91-21779
SEYFERT GALAXIES
The importance of submillimetre observations of radio quiet and radio loud AGN's N91-22000
SHADOWS
Power optimal single-axis articulating strategies
[NASA-CR-187510] N91-21581
SHAFTS (MACHINE ELEMENTS)
Dynamic modelling and analysis of a magnetically suspended flexible rotor N91-21208
SHEAR FLOW
Computation of turbulent high speed mixing layers using a two-equation turbulence model N91-21084
Wave models for turbulent free shear flows N91-21086
SHEAR LAYERS
Research in nonlinear water waves
[AD-A231205] N91-21477
SHEAR PROPERTIES
Mechanical behaviour of composite materials under impact loading N91-21250
Fracture toughness of unidirectional fiber reinforced ceramic composites in Mode 2 utilizing laser interferometry
[AD-A231027] N91-21258
Transverse cracking in a fiber reinforced ceramic matrix composite
[AD-A231029] N91-21259
SHEAR STRENGTH
A novel method of testing the shear strength of thick honeycomb composites
[NASA-TP-3108] N91-21242
SHEAR STRESS
Heat transfer, velocity-temperature correlation, and turbulent shear stress from Navier-Stokes computations of shock wave/turbulent boundary layer interaction flows N91-21085
A new type of shear specimen for measuring the interlaminar shear strength under impact loading N91-21246
The interlaminar shear strength of woven carbon, woven glass and woven carbon/glass hybrid laminates under static and impact loading N91-21247
Analysis of failure in woven carbon/epoxy laminates under quasi-static and impact loading N91-21248
Stress wave propagation in hybrid composite materials N91-21249
Data assimilation and wind-stress error correction in a forced tropical ocean model N91-21687
SHELL STABILITY
Stability analysis of a fuselage side
[FFA-TN-1990-32] N91-21568
SHIELDING
Comparison of beryllium and graphite first-walls in JET
[DE91-005489] N91-21884
SHIPS
Intercomparison of the chemical and meteorological data generated from aircraft and shipboard sampling during GCE/CASE/WATOX
[PB91-129098] N91-21667
SHOCK ABSORBERS
Determination of the flight hardware configuration of an energy absorbing attenuator for the proposed Space Station crew and equipment translation aid cart
[NASA-TP-3084] N91-21556
SHOCK TUBES
Possibilities of trajectory modification
[ISL-CO-209/90] N91-21151
Uniform high order spectral methods for one and two dimensional Euler equations
[NASA-CR-187535] N91-21456
SHOCK WAVE INTERACTION
Computation of laminar viscous-inviscid interactions in high-speed internal flows N91-21087
SHOCK WAVES
Two and three-dimensional shock-shock interactions on the blunt leading edges of the hypersonic inlets N91-21088
Deformation substructures induced by high-rate deformation
[DE91-008595] N91-21288
Data analysis for the Pioneer-Venus electric field detector
[NASA-CR-188099] N91-22056
SHOES
Engineering specification and system design for CAD/CAM of custom shoes: UMC project effort
[NASA-CR-188049] N91-21733
SIEVES
A systematic investigation of the preparation and properties of composite carbon molecular sieves containing inorganic oxides N91-21353
SIGNAL ANALYSIS
Signal parameter algorithms for trend analysis of digital data acquisition systems
[DE91-008171] N91-21749
SIGNAL DETECTION
A search for episodic increases in upper atmospheric water vapor as evidence of an extraterrestrial source
[AD-A231598] N91-21660
Intelligent array system
[AD-A231107] N91-21792
Transient solutions from scattered fields in a waveguide
[AD-A231124] N91-21838
Operation, maintenance, and research activities at NORSAR, NORESS, and ARCESS
[AD-A230874] N91-21970
SIGNAL FADING
Long-term performance and propagation measurements on single and tandem digital microwave transmission links. Volume 2: Appendixes
[PB91-129650] N91-21397
SIGNAL PROCESSING
Digital signal conditioning for flight test instrumentation
[NASA-TM-101739] N91-21135
A system for the real-time display of radar and video images of targets
[NASA-CR-188058] N91-21394
Long-term performance and propagation measurements on single and tandem digital microwave transmission links. Volume 2: Appendixes
[PB91-129650] N91-21397
The fast Hartley transform
[AD-A230370] N91-21400
Issues in providing a reliable multicast facility
[NASA-CR-188089] N91-21403
Comparative study of VLF signals in the sub-Antarctic region
[INPE-5165-TDL/426] N91-21406
High resolution beamforming on large aperture vertical line arrays: Processing synthetic data
[AD-A231054] N91-21415
Implementation of FFT and pulse compression routines on the SPT frequency domain array processor
[AD-A231320] N91-21443
A 200 Hz matched field processing on the September 1987 VLA data set
[AD-A231096] N91-21692
Fast algorithms for signal processing
[AD-A231226] N91-21759
Proceedings of the Second Joint Technology Workshop on Neural Networks and Fuzzy Logic, volume 1
[NASA-CP-10061-VOL-1] N91-21778
Intelligent array system
[AD-A231107] N91-21792
The necessity for a DOD capability in superconducting electronics
[AD-A231553] N91-21931
Operation, maintenance, and research activities at NORSAR, NORESS, and ARCESS
[AD-A230874] N91-21970
SIGNAL RECEPTION
Comparison of 14 decibels versus 20 decibels desired to undesired signal protection ratios
[DOT/FAA/CT-TN89/69] N91-21833
SIGNAL TO NOISE RATIOS
Noise factor and antenna gains in the signal/noise equation for over-the-horizon radar
[AD-A231203] N91-21416
Background issues for defensive interceptors
[DE91-009219] N91-21819
Comparison of 14 decibels versus 20 decibels desired to undesired signal protection ratios
[DOT/FAA/CT-TN89/69] N91-21833
Observation of spectral diffusion in crystals using single impurity molecules
[AD-A231338] N91-21926
SIGNAL TRANSMISSION
Transient solutions from scattered fields in a waveguide
[AD-A231124] N91-21838
SIGNATURES
Gust front/wind shift detection algorithm for the terminal Doppler weather radar
[DOT/FAA/NR-91/4] N91-21671
Classification of intermittent dependent observations
[AD-A231605] N91-21811
SILICATES
Vibrational frequencies for model silicates: Extensions beyond molecular properties
[DE91-008828] N91-21310
SILICIDES
In-situ diffraction and imaging studies of heteroepitaxial growth of semi-conductors
[AD-A231568] N91-21932
SILICON
High temperature deformation of silicon
[DE91-009102] N91-21305
Drop coalescence studies N91-21375
Silicon hybrid Wafer Scale Integration (WSI) used to fabricate a Hilbert transform integrated circuit module
[AD-A230605] N91-21428
Photoelectron spectroscopy of Si2
[AD-A230911] N91-21853
Optical switching and optical logic in a thermally expanding Si etalon
[AD-A230706] N91-21870
An investigation of Si-SiO2 interface charges in thermally oxidated (100), (110), (111), (511) silicon
[AD-A231244] N91-21923
Atomic layer epitaxy of silicon, silicon/germanium, and silicon carbide via extraction/exchange processes
[AD-A231348] N91-21927
SILICON ALLOYS
EBIC (Electron Beam Induced Current) contrast of clean, decorated and deuterium passivated Si(Ge) epitaxial misfit dislocations
[DE91-006967] N91-21912
SILICON CARBIDES
Mechanical behavior of fiber reinforced SiC/RBSN ceramic matrix composites: Theory and experiment
[NASA-TM-103688] N91-21243
Material properties of silicon carbide fibers with continuously applied sol-gel alumina coatings
[AD-A230825] N91-21256
The nucleation and growth of polycrystalline silicon carbide
[DE91-008887] N91-21304
Integrated synthesis and post processing of silicon carbide and aluminum nitride
[AD-A230810] N91-21317
Atomic layer epitaxy of silicon, silicon/germanium, and silicon carbide via extraction/exchange processes
[AD-A231348] N91-21927
SILICON FILMS
Nucleation and growth of diamond on Si, Cu and Au substrates
[AD-A231044] N91-21918
SILICON NITRIDES
Evaluation of bearing configurations using the single bearing tester in liquid nitrogen
[NASA-TM-103527] N91-21532
SILICON OXIDES
An investigation of Si-SiO2 interface charges in thermally oxidated (100), (110), (111), (511) silicon
[AD-A231244] N91-21923
SILICON TRANSISTORS
Monolithic integration of semiconductor and superconductor components
[AD-A231464] N91-21930
SILVER
Potentiometric titration of gold, platinum, and some other precious metals
[DE91-008989] N91-21276
Structural characterization of the Ag/YBa2Cu3O(7-x) interface
[DE91-009112] N91-21907
SIMPLE HARMONIC MOTION
A modal aeroelastic analysis scheme for turbomachinery blading
[NASA-CR-187089] N91-21138

SIMPLIFICATION
Experiments in cooperative-arm object manipulation with a two-armed free-flying robot
[NASA-CR-188028] N91-21529
The simplification of fuzzy control algorithm and hardware implementation N91-21781
SIMULATION
A simple, analytical, axisymmetric microburst model for downdraft estimation
[NASA-TM-104053] N91-21132
ICRF heating in reactor grade plasmas
[DE91-005491] N91-21886
SIMULATORS
Propulsion simulator for magnetically-suspended wind tunnel models N91-21198
Solid rocket booster internal flow analysis by highly accurate adaptive computational methods
[NASA-CR-184141] N91-21239
SINE WAVES
Experimental laboratory system to generate high frequency test environments
[DE91-008252] N91-21583
Sinusoidal response of a thin viscoplastic plate with severe temperature gradient
[AD-A230938] N91-21588
Application of Fourier-Fresnel imaging to neutral-atom interferometry
[AD-A231154] N91-21857
SINGLE CRYSTALS
Elastic response of zone axis (001)-oriented PWA 1480 single crystal: The influence of secondary orientation
[NASA-TM-103782] N91-21558
Experimental investigation of scattering of magnetostatic waves by surface acoustic waves
[DE91-009435] N91-21835
SINGULARITY (MATHEMATICS)
Description and evaluation of an interference assessment for a slotted-wall wind tunnel
[NASA-CR-4352] N91-21155
Singularities in water waves and Rayleigh-Taylor instability
[NASA-CR-187530] N91-21455
SIS (SEMICONDUCTORS)
The mm and sub-mm wave planar antenna arrays for SIS detectors N91-22046
SIS (SUPERCONDUCTORS)
Requirements for SIS receivers in the 500-1000 GHz region N91-22015
Development of components for submillimeter wave heterodyne radiometers at JPL N91-22017
SIZE DISTRIBUTION
Studies in clustering theory
[AD-A230967] N91-21475
SLABS
Toward high brightness, multi-kilowatt solid state lasers
[DE91-008990] N91-21504
SLENDER BODIES
Infrared thermography for the qualitative aerodynamic study of a slender body
[ISL-R-122/89] N91-21104
Coning motion of slender bodies at high angles of attack
[NAL-TR-1059] N91-21111
A simple model vortex flow past a slender elliptic cone at incidence
[RAE-TM-AERO-2197] N91-21460
SLENDER CONES
Investigation of nose bluntness and angle of attack effects on slender bodies in viscous hypertension flows
[NASA-CR-188153] N91-21117
SLEWING
Magnetic bearings with zero bias N91-21194
SLIDING
Sliding mode control of magnetic suspensions for precision pointing and tracking applications N91-21193
Tribological performance and deformation of sputter-deposited MoS2 solid lubricant films during sliding wear and indentation contact
[AD-A231003] N91-21547
SLOPES
Slant hot-wire inclination measurement using dual laser beams
[NAL-TR-1078] N91-21491
SLOTS
Description and evaluation of an interference assessment for a slotted-wall wind tunnel
[NASA-CR-4352] N91-21155
SLUSH
Frictional and retarding forces on aircraft tyres. Part 5: Estimation of fluid drag forces
[ESDU-90035] N91-21537
SMOOTHING
The microwave background: Its smoothness and frequency distribution as an astrophysical product
N91-21992
SOFTWARE ENGINEERING
AEOSS design guide for system analysis on Advanced Earth-Orbital Spacecraft Systems
[NASA-TM-100772] N91-21223
AEOSS runtime manual for system analysis on Advanced Earth-Orbital Spacecraft Systems
[NASA-TM-100773] N91-21224
Graphical user interfaces in computational chemistry
[DE91-009116] N91-21267
Engineering specification and system design for CAD/CAM of custom shoes: UMC project effort
[NASA-CR-188049] N91-21733
Automated computer software development standards enforcement
[DE91-007328] N91-21748
Engineering software development with HyperCard
N91-21942
Seven ways to make a hypertext project fail
N91-21946
The object the metaphor the power and evergreen or the eighth way to make a hypermedia project fail
N91-21947
Hypermedia and intelligent tutoring applications in a mission operations environment N91-21948
HEAVENS system for software artifacts N91-21958
SOFTWARE TOOLS
Automated computer software development standards enforcement
[DE91-007328] N91-21748
VHSIC Hardware Description Language (VHDL) benchmark suite
[AD-A231276] N91-21761
Tools for monitoring and controlling distributed applications
[NASA-CR-188034] N91-21770
SOIL MAPPING
TM/LANDSAT-5 multispectral reflectance for the remote sensing of the condition of bean crop vigor
[INPE-5184-PRE/1652] N91-21604
SOIL SCIENCE
Dynamics of vegetation and soils of oak/saw palmetto scrub after fire: Observations from permanent transects
[NASA-TM-103817] N91-21635
SOILS
Report of the panel on the land surface: Process of change, section 5 N91-21594
Dynamics of vegetation and soils of oak/saw palmetto scrub after fire: Observations from permanent transects
[NASA-TM-103817] N91-21635
SOL-GEL PROCESSES
Material properties of silicon carbide fibers with continuously applied sol-gel alumina coatings
[AD-A230825] N91-21256
Organic aerogels: A new type of ultrastructured polymer
[DE91-008500] N91-21312
Dip coating of sol-gels
[DE91-007571] N91-21872
SOLAR ACTIVITY
Comparative study of VLF signals in the sub-Antarctic region
[INPE-5165-TDL/426] N91-21406
Solar-geophysical data number 553, September 1990. Part 1: (Prompt reports). Data for August 1990, July 1990, and late data
[PB91-113019] N91-22059
SOLAR ARRAYS
Atomic oxygen degradation of Intelsat 4-type solar array interconnects: Laboratory investigations
[NASA-TM-102175] N91-21286
SOLAR CELLS
Atomic oxygen degradation of Intelsat 4-type solar array interconnects: Laboratory investigations
[NASA-TM-102175] N91-21286
High temperature deformation of silicon
[DE91-009102] N91-21305
Optimal design study of high efficiency indium phosphide space solar cells
[NASA-TM-103763] N91-21433
SOLAR FLARES
Space vehicle propulsion systems: Environmental space hazards
[NASA-CR-188094] N91-21236
Comparative study of VLF signals in the sub-Antarctic region
[INPE-5165-TDL/426] N91-21406
Proton depth dose distribution: 3-D calculation of dose distributions from solar flare irradiation
[AD-A231230] N91-22061
An unusual case of meter wave type-3 bursts leading millimeter-wave bursts
[INPE-5140-PRE/1628] N91-22064
SOLAR PHYSICS
Solar-geophysical data number 553, September 1990. Part 1: (Prompt reports). Data for August 1990, July 1990, and late data
[PB91-113019] N91-22059
SOLAR POSITION
Analysis of error in TOMS total ozone as a function of orbit and attitude parameters
[NASA-CR-4361] N91-21670
SOLAR RADIO EMISSION
Solar-geophysical data number 553, September 1990. Part 1: (Prompt reports). Data for August 1990, July 1990, and late data
[PB91-113019] N91-22059
SOLAR SAILS
Evaluation of transportation systems for advanced spaceflight missions
[DLR-FB-90-39] N91-21181
SOLAR SENSORS
Power optimal single-axis articulating strategies
[NASA-CR-187510] N91-21581
SOLAR TERRESTRIAL INTERACTIONS
Solar-geophysical data number 553, September 1990. Part 1: (Prompt reports). Data for August 1990, July 1990, and late data
[PB91-113019] N91-22059
SOLAR THERMAL PROPULSION
Evaluation of transportation systems for advanced spaceflight missions
[DLR-FB-90-39] N91-21181
SOLDERED JOINTS
Superplastic creep of eutectic tin-lead solder joints
[DE91-009074] N91-21586
SOLENOIDS
A superconducting large-angle magnetic suspension
N91-21191
Magnetic suspension and balance system advanced study, 1989 design N91-21197
SOLID LUBRICANTS
Mechanical strength and thermophysical properties of PM212: A high temperature self-lubricating powder metallurgy composite
[NASA-TM-103694] N91-21302
Tribological performance and deformation of sputter-deposited MoS2 solid lubricant films during sliding wear and indentation contact
[AD-A231003] N91-21547
SOLID PROPELLANT ROCKET ENGINES
Kauai Test Facility two experiment rocket campaign
[DE91-008894] N91-21172
Flight motor set 360T010 (STS-31R). Volume 1: System overview
[NASA-CR-184104] N91-21231
Solid rocket booster internal flow analysis by highly accurate adaptive computational methods
[NASA-CR-184141] N91-21239
SOLID SOLUTIONS
On the crystal structure of boron carbides
[DE91-009256] N91-21914
SOLID STATE DEVICES
A solid-state controllable power supply for a magnetic suspension wind tunnel N91-21199
SOLID STATE LASERS
Toward high brightness, multi-kilowatt solid state lasers
[DE91-008990] N91-21504
SOLID WASTES
Technology transfer needs assessment, 1990
[PB91-125674] N91-21985
SOLID-SOLID INTERFACES
An investigation of Si-SiO2 interface charges in thermally oxidated (100), (110), (111), (511) silicon
[AD-A231244] N91-21923
SOLIDIFICATION
Containerless experiments in fluid physics in microgravity N91-21341
Experiments for electromagnetic levitation in microgravity N91-21348
Undercooling of acoustically levitated molten drops
N91-21359
Multiple sensor multifrequency eddy current monitor for solidification and growth N91-21362
Center for low-gravity fluid mechanics and transport phenomena
[NASA-CR-188048] N91-21452
SOLIDS
A high temperature thermal diffusivity determination procedure for solids and liquids N91-21377
Finding a single molecule in a haystack: Laser spectroscopy of solids from square root of (N to N) = 1
[AD-A230910] N91-21521
Update of PRONTO 2D and PRONTO 3D transient solid dynamics program
[DE91-009183] N91-21564

PALM2D: A nonlinear finite element program for the coupled thermomechanical response of solids in two dimensions
[DE91-008423] N91-21584
SOLITARY WAVES
The organic chemistry of conducting polymers
[DE91-009520] N91-21316
SONAR
High resolution beamforming on large aperture vertical line arrays: Processing synthetic data
[AD-A231054] N91-21415
A 200 Hz matched field processing on the September 1987 VLA data set
[AD-A231096] N91-21692
SOUND FIELDS
Statistical properties of the sea surface sound dipole source
[AD-A230811] N91-21688
SOUND GENERATORS
The sound of moving bodies
[NASA-TM-103342] N91-21827
SOUND TRANSMISSION
Analysis of 200 Hz CW tone propagation signal recorded during the September 1987 VLA experiment
[AD-A231053] N91-21414
SOUND WAVES
A new, simple electrostatic-acoustic hybrid levitator N91-21369
Analysis of 200 Hz CW tone propagation signal recorded during the September 1987 VLA experiment
[AD-A231053] N91-21414
High resolution beamforming on large aperture vertical line arrays: Processing synthetic data
[AD-A231054] N91-21415
The sound of moving bodies
[NASA-TM-103342] N91-21827
Experimental investigation of scattering of magnetostatic waves by surface acoustic waves
[DE91-009435] N91-21835
High-frequency acoustic scattering
[AD-A230880] N91-21836
Transient solutions from scattered fields in a waveguide
[AD-A231124] N91-21838
SOVIET SPACECRAFT
The energy source rocket of the Soviet Union
[AD-A224938] N91-21229
SOYBEANS
Use of direct expansion for estimation of soybean and corn areas through multispectral and temporal LANDSAT/TM data
[INPE-5180-PRE/1649] N91-21609
Spectral responses of soybean and cotton from Landsat/TM digital data
[INPE-5179-PRE/1648] N91-21614
SPACE CHARGE
Observation of the photorefractive effect in a polymer
[AD-A231339] N91-21322
SPACE COMMERCIALIZATION
Commercial space programs N91-21983
SPACE DEBRIS
The micrometeoroid impact hazard in space: Techniques for damage simulation by pulsed lasers and environmental modelling N91-21220
Orbital debris sweeper and method
[NASA-CASE-MSC-21534-1] N91-21222
SPACE EXPLORATION
Aeronautics and space technology N91-21981
Space science and applications N91-21982
SPACE FLIGHT
Magnetic bearings for a spaceflight optical disk recorder N91-21195
SPACE HABITATS
Offshore technology R and D in space applications N91-21162
SPACE INDUSTRIALIZATION
Commercial space programs N91-21983
SPACE LABORATORIES
TEMPUS: First results N91-21350
SPACE MANUFACTURING
Zeolites in space N91-21165
SPACE MISSIONS
Power technologies and the space future
[NASA-TM-103649] N91-21240
A knowledge base browser using hypermedia N91-21956
SPACE PLATFORMS
The single antenna interferometer
[DE91-007128] N91-21407
SPACE PROCESSING
Very high temperature chemistry: Science justification for containerless experimentation in space N91-21334
NASA-sponsored containerless processing experiments N91-21335
Experiments for electromagnetic levitation in microgravity N91-21348
TEMPUS: A facility for containerless electromagnetic processing onboard spacelab N91-21349
TEMPUS: First results N91-21350
Reluctant glass formers and their applications in optical lens design N91-21351
Containerless protein crystal growth technology: Electrostatic multidrop positioner N91-21352
A systematic investigation of the preparation and properties of composite carbon molecular sieves containing inorganic oxides N91-21353
High temperature metal purification using a compact portable rf heating and levitation system on the wake shield N91-21365
Optical property measurements as a diagnostic tool for control of materials processing in space and on Earth N91-21366
High temperature acoustic and hybrid microwave/acoustic levitators for materials processing N91-21368
A new, simple electrostatic-acoustic hybrid levitator N91-21369
Feedback controlled electrostatic and electromagnetic sample positioners N91-21370
Some considerations for various positioning systems and their science capabilities N91-21372
Radiographic instrumentation for DPM experiments N91-21373
An examination of anticipated g-jitter on space station and its effects on materials processes
[NASA-TM-103775] N91-21378
Spiral vane bioreactor
[NASA-CASE-MSC-21361-1] N91-21701
Space science and applications N91-21982
SPACE PROGRAMS
From Earth to space and back: Selected papers on Norwegian space activities
[NSC-REPT(90)2] N91-21159
Development of Norwegian space activities N91-21160
Space research in Norway N91-21167
Power technologies and the space future
[NASA-TM-103649] N91-21240
Commercial space programs N91-21983
SPACE SHUTTLE BOOSTERS
Flight set 360L007 (STS-33) insulation component. Volume 3: Final release
[NASA-CR-184091] N91-21230
Solid rocket booster internal flow analysis by highly accurate adaptive computational methods
[NASA-CR-184141] N91-21239
SPACE SHUTTLE MAIN ENGINE
An evaluation of GTAW-P versus GTA welding of alloy 718
[NASA-TM-103529] N91-21287
Modeling of rolling element bearing mechanics
[NASA-CR-188045] N91-21530
Evaluation of bearing configurations using the single bearing tester in liquid nitrogen
[NASA-TM-103527] N91-21532
SPACE SHUTTLE ORBITERS
Shuttle Entry Air Data System (SEADS) hardware development. Volume 1: Summary
[NASA-CR-166044-VOL-1] N91-21179
Shuttle Entry Air Data System (SEADS) hardware development. Volume 2: History
[NASA-CR-166044-VOL-2] N91-21180
SPACE SHUTTLE PAYLOADS
Pre-integrated structures for Space Station Freedom
[NASA-TM-102780] N91-21214
SPACE SHUTTLES
Atmospheric environment for space shuttle (STS-38) launch
[NASA-TM-103530] N91-21633
Ventilation loss and pressurization in the NASA launch/entry suit: Potential for heat stress
[NASA-CR-188075] N91-21719
NASA space shuttle/space station N91-21979
SPACE STATION STRUCTURES
Pre-integrated structures for Space Station Freedom
[NASA-TM-102780] N91-21214
Overcenter collet space station truss fastener
[NASA-CASE-MSC-21504-1] N91-21221
SPACE STATIONS
Fire suppression in human-crew spacecraft
[NASA-TM-104334] N91-21182
Aerobrake assembly with minimum Space Station accommodation
[NASA-TM-102778] N91-21183
Space station: NASA's search for design, cost, and schedule stability continues
[GAO/NSIAD-91-125] N91-21187
Dynamic and control assessment of the Space Station Freedom payload pointing system
[NASA-TM-101667] N91-21225
An examination of anticipated g-jitter on space station and its effects on materials processes
[NASA-TM-103775] N91-21378
Determination of the flight hardware configuration of an energy absorbing attenuator for the proposed Space Station crew and equipment translation aid cart
[NASA-TP-3084] N91-21556
On-orbit damage detection and health monitoring of large space trusses: Status and critical issues
[NASA-TM-104045] N91-21579
GERM as a tool for space station documentation N91-21950
XTP for the NASA space station
[NASA-CR-188087] N91-21966
NASA space shuttle/space station N91-21979
SPACE SUITS
Ventilation loss and pressurization in the NASA launch/entry suit: Potential for heat stress
[NASA-CR-188075] N91-21719
SPACE TRANSPORTATION
Evaluation of transportation systems for advanced spaceflight missions
[DLR-FB-90-39] N91-21181
Commercial space programs N91-21983
SPACE TRANSPORTATION SYSTEM FLIGHTS
Atmospheric environment for space shuttle (STS-38) launch
[NASA-TM-103530] N91-21633
SPACE WEAPONS
Notes on space, satellites, and survivability
[DE91-009229] N91-21226
Geomagnetic model investigations for 1980 - 1989: A model for strategic defense initiative particle beam experiments and a study in the effects of data types and observatory bias solutions
[NASA-TM-104541] N91-21654
Requirements for progressive strategic defenses
[DE91-008997] N91-21812
Near-term boost-phase defense sensitivities
[DE91-008999] N91-21813
Strategic defense requirements for progressive applications
[DE91-009045] N91-21816
Threat modernization in the near term
[DE91-009228] N91-21817
Discrimination options in the near term
[DE91-009000] N91-21818
SPACEBORNE ASTRONOMY
FIRST: Far Infrared and Submillimeter Space Telescope N91-21990
LDR: A submillimeter great observatory N91-22018
A submillimeter mission for the 1990s: SMMM N91-22019
The submillimeter wave astronomy satellite N91-22025
FIR and sub-mm direct detection spectrometers for spaceborne astronomy N91-22026
Radiatively-cooled telescopes for infrared space astronomy N91-22048
Telescope technology for space-borne submillimeter astronomy N91-22049
MOSES: A proposed Swedish submillimeter satellite for combined astronomical and atmospheric observations N91-22050
SPACEBORNE EXPERIMENTS
Control issues of microgravity vibration isolation N91-21192
Very high temperature chemistry: Science justification for containerless experimentation in space N91-21334
Containerless processing projects N91-21336
SPACEBORNE TELESCOPES
FIRST: Far Infrared and Submillimeter Space Telescope N91-21990
Japanese space programmes of IR and sub-mm astronomy N91-21997
A submillimeter mission for the 1990s: SMMM N91-22019
FIR and sub-mm direct detection spectrometers for spaceborne astronomy N91-22026
SPACECRAFT CHARGING
Norwegian studies of plasma modifications around spacecraft and how these affect the vehicle potential N91-21166
SPACECRAFT CONSTRUCTION MATERIALS
Materials for aerospace vehicles friction drag reduction surfaces
[INPE-5188-PRE/1656] N91-21217
SPACECRAFT CONTROL
The spacecraft control laboratory experiment optical attitude measurement system
[NASA-TM-102624] N91-21186
Dynamic and control assessment of the Space Station Freedom payload pointing system
[NASA-TM-101667] N91-21225

SPACECRAFT DEFENSE
Notes on space, satellites, and survivability
[DE91-009229] N91-21226
SPACECRAFT DESIGN
Shuttle Entry Air Data System (SEADS) hardware development. Volume 1: Summary
[NASA-CR-166044-VOL-1] N91-21179
Shuttle Entry Air Data System (SEADS) hardware development. Volume 2: History
[NASA-CR-166044-VOL-2] N91-21180
Aerobrake assembly with minimum Space Station accommodation
[NASA-TM-102778] N91-21183
Requirements and trade-off studies in satellite mechanical architecture
[INPE-5186-PRE/1654] N91-21219
A submillimeter mission for the 1990s: SMMM N91-22019
SPACECRAFT DOCKING
Dynamic and control assessment of the Space Station Freedom payload pointing system
[NASA-TM-101667] N91-21225
SPACECRAFT ENVIRONMENTS
Redistribution of particulates on a payload during flight ascent
[NASA-TM-104539] N91-21255
Exploring the living universe: A strategy for space life sciences
[NASA-TM-103399] N91-21696
SPACECRAFT INSTRUMENTS
Navigation Experiment NAVEX: Measurement and performance of the spaceborne clocks
[ESA-TT-1209] N91-21823
SPACECRAFT LAUNCHING
Quality function deployment in launch operations
[AD-A230983] N91-21178
Redistribution of particulates on a payload during flight ascent
[NASA-TM-104539] N91-21255
Atmospheric environment for space shuttle (STS-38) launch
[NASA-TM-103530] N91-21633
SPACECRAFT MANEUVERS
A stochastic approach to the problem of spacecraft optimal manoeuvres
[INPE-5192-PRE/1660] N91-21171
SPACECRAFT ORBITS
A stochastic approach to the problem of spacecraft optimal manoeuvres
[INPE-5192-PRE/1660] N91-21171
SPACECRAFT PROPULSION
Evaluation of transportation systems for advanced spaceflight missions
[DLR-FB-90-39] N91-21181
Cooling of in-situ propellant rocket engines for Mars mission
[NASA-TM-103729] N91-21233
SPACECRAFT STABILITY
Dynamic and control assessment of the Space Station Freedom payload pointing system
[NASA-TM-101667] N91-21225
SPACECRAFT STRUCTURES
Closed-form solutions for linear regulator design of mechanical systems including optimal weighting matrix selection
[NASA-TM-104052] N91-21572
SPACELAB
TEMPUS: A facility for containerless electromagnetic processing onboard spacelab N91-21349
Cosmic Ray Nuclei (CRN) detector investigation
[NASA-CR-184137] N91-22063
SPALLING
Analysis of rolling contact spall life in 440 C steel bearing rims
[NASA-CR-184101] N91-21526
SPARK PLUGS
Spark-ignited diesel engine
[AD-A230243] N91-21533
SPATIAL DISTRIBUTION
Effects of source correlations on the spectrum of radiated fields
[AD-A230955] N91-21411
Comparative analysis of AVHRR/NOAA and TM/LANDSAT data in the delimitation of savanna/forest contact area: Preliminary results
[INPE-5200-RPE/639] N91-21611
Evaluation of indigenous areas utilizing TM/LANDSAT data
[INPE-5173-PRE/1642] N91-21636
User's manual for SLAB: An atmospheric dispersion model for denser-than-air-releases
[DE91-008443] N91-21638
Power spectra of internal gravity waves
[AD-A231596] N91-21659
Case study analysis of clustering applied to VAS measurements
[PB91-127829] N91-21666
Radiation dose calculations with the Monte Carlo method
[DE91-008582] N91-21841
SPATIAL RESOLUTION
Laser diagnostics for plasma turbulence
[DE91-009377] N91-21899
SPECIFIC IMPULSE
Theoretical studies of highly energetic CBES materials
[AD-A231340] N91-21329
Theoretical investigation of energy storage in atomic and molecular systems: Metastable molecular fuels
[AD-A230854] N91-21852
SPECIFICATIONS
Specification of the autonomous missile guidance problem for the TA11 processor. Volume 4: Processor mini-spec
[FFI-90/4005-VOL-4] N91-21145
Specification of the autonomous missile guidance problem for the TA11 processor. Volume 6: Specification mode 16, N
[FFI-90/4005-VOL-6] N91-21146
Specification of the autonomous missile guidance problem for the TA11 processor. Volume 7: Specification mode 29, N + A + T + H
[FFI-90/4005-VOL-7] N91-21147
Specification of the autonomous missile guidance problem for the TA11 processor. Volume 8: Specification mode 30, N + A + T + B
[FFI-90/4005-VOL-8] N91-21148
Flight motor set 360T010 (STS-31R). Volume 1: System overview
[NASA-CR-184104] N91-21231
Beam line and associated work
[AD-A231243] N91-21867
SPECIMEN GEOMETRY
A new type of shear specimen for measuring the interlaminar shear strength under impact loading N91-21246
Flat tensile specimen design for advanced composites
[NASA-CR-185261] N91-21252
SPECTRA
Application of the finite element method to random rough surface scattering with Neumann boundary conditions
[AD-A231583] N91-21420
Correlative studies between spectral responses and weathering indices of alternate weathered cover
[INPE-5176-PRE/1645] N91-21618
SPECTRAL BANDS
Proof of the feasibility of coherent and incoherent schemes for pumping a gamma ray laser
[AD-A230897] N91-21520
SPECTRAL EMISSION
Japanese space programmes of IR and sub-mm astronomy N91-21997
Large-scale (CII) 158 micron emission of the Galaxy observed by a balloon-borne telescope N91-22004
A highly collimated bipolar outflow in the core of OMC-1: CO submillimeter emission N91-22014
Submillimeter water masers at 321 and 325 GHz N91-22023
SPECTRAL ENERGY DISTRIBUTION
Power spectra of internal gravity waves
[AD-A231596] N91-21659
SPECTRAL LINE WIDTH
Time-resolved extreme-ultraviolet spectroscopy of laser-produced plasmas originating at the parylene layer of microballon targets
[DE91-009378] N91-21900
SPECTRAL METHODS
Computational study of three dimensional viscous flow through a turbine cascade using a multi-domain spectral technique N91-21066
Uniform high order spectral methods for one and two dimensional Euler equations
[NASA-CR-187535] N91-21456
On one-sided filters for spectral Fourier approximations of discontinuous functions
[NASA-CR-187541] N91-21801
Spectral analysis of annual sunspot series: An update
[INPE-5207-PRE/1669] N91-22060
SPECTRAL REFLECTANCE
TM/LANDSAT-5 multispectral reflectance for the remote sensing of the condition of bean crop vigor
[INPE-5184-PRE/1652] N91-21604
Spectral responses of soybean and cotton from Landsat/TM digital data
[INPE-5179-PRE/1648] N91-21614
SPECTRAL SIGNATURES
A search for episodic increases in upper atmospheric water vapor as evidence of an extraterrestrial source
[AD-A231598] N91-21660
SPECTRAL THEORY
Effects of source correlations on the spectrum of radiated fields
[AD-A230955] N91-21411
Chaotic spectra of small molecules
[AD-A231638] N91-21859
SPECTROMETERS
Applications and current limitations of matrix-assisted laser desorption Fourier transform mass spectrometry for biomolecules
[DE91-008877] N91-21265
A study of helium. Argon: Ethane gas mixtures used in drift chambers for large acceptance spectrometers in high magnetic fields
[AD-A231209] N91-21284
New Cologne acousto-optical spectrometer projects N91-22034
A flexible hybrid spectrometer for balloon borne and ground based (sub)millimeter wavelength astronomy N91-22043
Performance tests on Ge:Ga and Ge:Be detectors for the ISO long wavelength spectrometer N91-22045
SPECTROSCOPIC ANALYSIS
Pressure dependence of deep centers by capacitance spectroscopies inside the diamond anvil cell
[DE91-008927] N91-21906
SPECTROSCOPIC TELESCOPES
Far-infrared heterodyne technology N91-22016
A submillimeter mission for the 1990s: SMMM N91-22019
The submillimeter wave astronomy satellite N91-22025
FIR and sub-mm direct detection spectrometers for spaceborne astronomy N91-22026
The Caltech Submillimeter Observatory N91-22032
SPECTROSCOPY
The use of a scanning electrochemicl impedance spectroscopy technique to investigate localized corrosion
[DE91-006918] N91-21296
Submillimetre observations of solar-system objects N91-22037
SPECTRUM ANALYSIS
The fast Hartley transform
[AD-A230370] N91-21400
Definition of the concept of an interferometric spectrum analyzer for the detection of frequency hopping radios
[AD-A231031] N91-21413
Spectral characteristics of agricultural crops and yield
[INPE-5125-RPE/630] N91-21619
Estimations of ABL fluxes and other turbulence parameters from Doppler lidar data
[NASA-CR-188053] N91-21665
Chaotic spectra of small molecules
[AD-A231638] N91-21859
Spectral analysis of the heliotron field with the toroidal harmonic function in a study of the structure of built-in divertor
[NIFS-71] N91-21892
The galactic center at submillimeter and far-infrared wavelengths N91-22002
Performance tests on Ge:Ga and Ge:Be detectors for the ISO long wavelength spectrometer N91-22045
MOSES: A proposed Swedish submillimeter satellite for combined astronomical and atmospheric observations N91-22050
Spectral analysis of annual sunspot series: An update
[INPE-5207-PRE/1669] N91-22060
SPEECH
Speech recognition using Kohonen neural networks, dynamic programming, and multi-feature fusion
[AD-A230951] N91-21410
SPEECH RECOGNITION
Speech recognition using Kohonen neural networks, dynamic programming, and multi-feature fusion
[AD-A230951] N91-21410
Construction site Voice Operated Information System (VOIS) test
[AD-A231633] N91-21424
SPHERICAL COORDINATES
Finite difference form of the compressible boundary layer equations in generalized curvilinear coordinates
[AD-A231386] N91-21483
SPHERICAL SHELLS
The metrology of spherical shells using synchrotron x ray microtomography N91-21374
SPINDLES
Laser test for spindle parallelism
[DE91-009716] N91-21518
SPIRAL GALAXIES
The (C II) 158 micron line mapping of spiral galaxies N91-21996
SPOILERS
Lift and rolling moment due to spoilers on wings at subsonic speeds
[ESDU-90030] N91-21129

SPONTANEOUS EMISSION
Advanced, time-resolved imaging techniques for electron-beam characterizations
[DE91-008587] N91-21865
SPRAY CHARACTERISTICS
Comparison of UNL laser imaging and sizing system and a phase Doppler system for analyzing sprays from a NASA nozzle
[NASA-CR-185239] N91-21485
SPRAYED COATINGS
Preparation and characterization of Iron(III) oxide films by an novel spray pyrolysis method
[AD-A231047] N91-21920
SPRAYERS
Chemical spray pyrolysis of Tl-Ba-Ca-Cu-O high-T(sub c) superconductors for high-field bitter magnets N91-21212
Spray combustion modeling and evaluation
[DE91-007923] N91-21264
SPREAD SPECTRUM TRANSMISSION
Excision techniques in direct sequence spread spectrum communication systems
[AD-A231290] N91-21763
STABILITY
On the nonlinear stability of a high-speed, axisymmetric boundary layer
[NASA-CR-187538] N91-21099
Oscillational instabilities in single mode acoustics levitators N91-21376
Identification of linear multivariable systems from a single set of data by identification of observers with assigned real eigenvalues
[NASA-TM-102669] N91-21575
Nonlinear symmetric instability and oscillations in the tropical atmosphere N91-21674
Adaptive detection in subspaces
[AD-A231023] N91-21876
The series Bi2Sr2Ca(n-1) Cu(n)O(2n+4) (1 less than or equal to n less than or equal to 5): Phase stability and superconducting properties
[NASA-TM-103749] N91-21910
Interplay between local environment effect and electronic structure properties in close packed structures
[DE91-008506] N91-21915
STABILITY TESTS
Rotary-balance testing for aircraft dynamics
[AGARD-AR-265] N91-21156
STABILIZATION
Sawteeth and their stabilization in JET
[DE91-005459] N91-21882
STAGNATION POINT
Constant-current stagnation-point film-anemometer probe
[AD-A231048] N91-21501
STAINLESS STEELS
Evaluation of bearing configurations using the single bearing tester in liquid nitrogen
[NASA-TM-103527] N91-21532
STANDARDIZATION
Data element dictionary: Technical report database, part 1
[AD-A230836] N91-21969
STANDARDS
The physiological effects of 50/60 Hz electromagnetic fields: Standards and guidelines
[DE91-752996] N91-21705
Experience with abstract notation one
[NASA-CR-188090] N91-21741
Automated computer software development standards enforcement
[DE91-007328] N91-21748
STAR FORMATION
The (C II) 158 micron line mapping of spiral galaxies N91-21996
Submillimeter astronomy and low mass star formation N91-22012
Interstellar chemistry and submillimetre astronomy N91-22021
Submillimeter water masers at 321 and 325 GHz N91-22023
The search for protostars in high mass star forming regions N91-22030
STAR TRACKERS
Redistribution of particulates on a payload during flight ascent
[NASA-TM-104539] N91-21255
STATE ESTIMATION
Flight path reconstruction using extended Kalman filtering techniques
[DLR-FB-90-41] N91-21108
STATIC LOADS
A discourse on sensitivity analysis for discretely-modeled structures
[NASA-TM-104065] N91-21577
STATIC PRESSURE
An experimental study of exit flow patterns in a multistage compressor in rotating stall
[AD-A231353] N91-21143
STATIC TESTS
Static thrust-vectoring performance of nonaxisymmetric convergent-divergent nozzles with post-exit yaw vanes
[NASA-TP-3085] N91-21059
STATIC THRUST
Static thrust-vectoring performance of nonaxisymmetric convergent-divergent nozzles with post-exit yaw vanes
[NASA-TP-3085] N91-21059
STATISTICAL ANALYSIS
Study of bird ingestions into small inlet area aircraft turbine engines
[DOT/FAA/CT-90/13] N91-21122
The overall response of composite materials undergoing large elastic deformations
[AD-A231637] N91-21260
An evaluation of GTAW-P versus GTA welding of alloy 718
[NASA-TM-103529] N91-21287
Variational method in the statistical theory of turbulence
[AD-A231621] N91-21484
Use of direct expansion for estimation of soybean and corn areas through multispectral and temporal LANDSAT/TM data
[INPE-5180-PRE/1649] N91-21609
Statistical properties of the sea surface sound dipole source
[AD-A230811] N91-21688
Objective use of satellite altimetry and IR in simulations of western boundary current dynamics
[AD-A231628] N91-21695
Uncertainty estimates for derivatives and intercepts
[DE91-004503] N91-21802
Bayesian analysis of constrained parameter and truncated data problems
[AD-A231080] N91-21810
STATISTICAL CORRELATION
Non-airborne conflicts: The causes and effects of runway transgressions
[NASA-CR-177372] N91-21121
Comparative analysis of AVHRR/NOAA and TM/LANDSAT data in the delimitation of savanna/forest contact area: Preliminary results
[INPE-5200-RPE/639] N91-21611
STATISTICAL WEATHER FORECASTING
Statistical forecasting of precipitation associated with the passage of frontal systems in the south region of Brazil
[INPE-5208-TDL/429] N91-21672
STATORS
Numerical solutions of 2-D multi-stage rotor/stator unsteady flow interactions N91-21070
STEAM
Wet atmospheric generation apparatus
[NASA-CASE-MFS-28177-1] N91-21496
Theoretical investigation of the injection and evaporation of water in a hydrogen/oxygen steam generator
[DLR-FB-90-20] N91-21938
STEELS
Micromechanisms of friction in electrogalvanized sheet steel with emphasis on the role of texture
[DE91-009113] N91-21290
Analysis of rolling contact spall life in 440 C steel bearing rims
[NASA-CR-184101] N91-21526
Effective cleaning of oil-protected bearing steel examined by XPS analysis. Part 1: Cleaning by solvents and alkaline cleaners
[NAL-TR-1074] N91-21538
STELLAR ENVELOPES
Late-type stars at far-infrared and sub-millimeter wavelengths N91-22006
First detection of C3H2 at sub-mm wavelengths N91-22022
Submillimeter water masers at 321 and 325 GHz N91-22023
Excitation of submillimeter water masers N91-22024
STELLAR EVOLUTION
Late-type stars at far-infrared and sub-millimeter wavelengths N91-22006
Submillimeter astronomy and low mass star formation N91-22012
STELLAR MASS
The search for protostars in high mass star forming regions N91-22030
STELLAR OCCULTATION
A search for stellar occultations by Uranus, Neptune, Pluto, and their satellites: 1990-1999
[NASA-CR-188146] N91-22053
STELLAR RADIATION
The 1.3 mm continuum emission from circumstellar envelopes N91-22007
STELLAR SPECTRA
The galactic center at submillimeter and far-infrared wavelengths N91-22002
First detection of C3H2 at sub-mm wavelengths N91-22022
Excitation of submillimeter water masers N91-22024
STELLARATORS
Observation of parallel viscosity in the CHS heliotron/torsatron
[NIFS-70] N91-21891
STEREOSCOPIC VISION
Spot 1: Imagery in geologic mapping: A comparative study with several remote sensing products in the Curaca River Valley, Bahia
[INPE-5136-PRE/1624] N91-21608
STERILIZATION
International document on food irradiation
[DE91-615879] N91-21715
STIFFNESS
Dynamic modelling and analysis of a magnetically suspended flexible rotor N91-21208
Closed-form solutions for linear regulator design of mechanical systems including optimal weighting matrix selection
[NASA-TM-104052] N91-21572
A fully Galerkin method for the recovery of stiffness and damping parameters in Euler-Bernoulli beam models
[NASA-CR-187517] N91-21796
STOCHASTIC PROCESSES
A stochastic approach to the problem of spacecraft optimal manoeuvres
[INPE-5192-PRE/1660] N91-21171
Using a microgravity environment to probe wave turbulence N91-21355
Stochastic and deterministic fluctuations in stimulated Brillouin scattering
[AD-A230988] N91-21522
Deterministic and stochastic sensitivity in computational structural mechanics
[ISSN-0208-5658] N91-21571
Identification of parameters derived from inertial sensors
[INPE-5166-RPE/637] N91-21746
STOCKPILING
Supervision of peat stockpiles using aerial thermography
[DE91-752966] N91-21622
STORAGE RINGS (PARTICLE ACCELERATORS)
Diffusive transport enhancement by isolated resonances and distribution tails growth in hadronic beams
[DE91-006379] N91-21864
STORM DAMAGE
Features of the Raleigh tornadic storm based on analysis of damage
[AD-A231601] N91-21684
STORMS
Features of the Raleigh tornadic storm based on analysis of damage
[AD-A231601] N91-21684
STRAIN DISTRIBUTION
Mechanical strain isolator mount
[NASA-CASE-LAR-13580-1] N91-21541
STRAIN ENERGY RELEASE RATE
Contributions to the analysis of the DCB-specimen
[FFA-TN-1990-22] N91-21567
STRAIN GAGES
Stress-strain gage measurements on a Nevada Test Site (NTS) event using pairs of triple foil gages
[DE91-005061] N91-21497
STRAIN MEASUREMENT
Electro optical system to measure strains at high temperature
[NASA-CR-188148] N91-21492
STRAIN RATE
Effect of strain rate on the through-thickness elastic properties of woven laminates N91-21245
A new type of shear specimen for measuring the interlaminar shear strength under impact loading N91-21246
Deformation substructures induced by high-rate deformation
[DE91-008595] N91-21288
Update of PRONTO 2D and PRONTO 3D transient solid dynamics program
[DE91-009183] N91-21564
STRANGENESS
Strange particles production and absorption in nuclei at high energies
[DE91-620399] N91-21845
STRATEGY
Requirements for progressive strategic defenses
[DE91-008997] N91-21812
Strategic defense system: Stable design and adequate testing must precede decision to deploy
[AD-A230864] N91-21820

STRATIGRAPHY
Volcanic-sedimentary sequence of the Greenstone Belt type in the Santa Rita or Goias elevation: An approach with TM-Landsat data
[INPE-5178-PRE/1647] N91-21610
STRATOSPHERE
Volcanic aerosols: Chemistry, evolution, and effects N91-21645
Volcanic effects on climate N91-21646
Nonlinear symmetric instability and oscillations in the tropical atmosphere N91-21674
STRATOSPHERE RADIATION
SOFIA: The Stratospheric Observatory For Infrared Astronomy N91-22003
STRATUS CLOUDS
Stratus surge prediction along the Central California coast
[PB91-129239] N91-21668
STRESS (PHYSIOLOGY)
Ventilation loss and pressurization in the NASA launch/entry suit: Potential for heat stress
[NASA-CR-188075] N91-21719
STRESS ANALYSIS
Stress wave propagation in hybrid composite materials N91-21249
Delamination and free edge stresses in laminated plates subjected to constant uniaxial strain (computer program)
[ESDU-90021] N91-21253
Elastic response of zone axis (001)-oriented PWA 1480 single crystal: The influence of secondary orientation
[NASA-TM-103782] N91-21558
STRESS CONCENTRATION
Analysis of failure in woven carbon/epoxy laminates under quasi-static and impact loading N91-21248
Flat tensile specimen design for advanced composites
[NASA-CR-185261] N91-21252
STRESS MEASUREMENT
Measurement of residual stresses by x ray diffraction near simulated heat affected zones in austenitic stainless steels
[DE91-008874] N91-21289
STRESS RELAXATION
A simple test for thermomechanical evaluation of ceramic fibers
[NASA-TM-103767] N91-21309
STRESS WAVES
Stress wave propagation in hybrid composite materials N91-21249
STRESS-STRAIN RELATIONSHIPS
Stress-strain gage measurements on a Nevada Test Site (NTS) event using pairs of triple foil gages
[DE91-005061] N91-21497
HITCAN for actively cooled hot-composite thermostructural analysis
[NASA-TM-103750] N91-21562
Contributions to the analysis of the DCB-specimen
[FFA-TN-1990-22] N91-21567
Sinusoidal response of a thin viscoplastic plate with severe temperature gradient
[AD-A230938] N91-21588
STRESSES
Transverse cracking in a fiber reinforced ceramic matrix composite
[AD-A231029] N91-21259
Stress-strain gage measurements on a Nevada Test Site (NTS) event using pairs of triple foil gages
[DE91-005061] N91-21497
Tribological performance and deformation of sputter-deposited MoS2 solid lubricant films during sliding wear and indentation contact
[AD-A231003] N91-21547
STRINGS
Early COBE results and superconducting cosmic strings N91-21989
STRONGLY COUPLED PLASMAS
The streamlined Darwin field method (and a solution technique that makes it practical)
[DE91-009482] N91-21903
STRONTIUM
Laser pulse compression in strontium and calcium vapor
[DE91-007346] N91-21511
STRUCTURAL ANALYSIS
Thermomechanics tasks and applications
[DLR-MITT-90-14] N91-21254
Engineering property limitations of structural ceramics and ceramic composites above 1600 C
[DE91-009105] N91-21311
Analysis and design of antenna structures: Diakoptic theory and the moment method
[AD-A230838] N91-21438
Application of mesh generation to complex 3-D configurations
[AGARD-AR-268] N91-21464
Applications of artificial neural nets in structural mechanics
[NASA-TM-102420] N91-21559
HITCAN for actively cooled hot-composite thermostructural analysis
[NASA-TM-103750] N91-21562
Contributions to the analysis of the DCB-specimen
[FFA-TN-1990-22] N91-21567
Stability analysis of a fuselage side
[FFA-TN-1990-32] N91-21568
Deterministic and stochastic sensitivity in computational structural mechanics
[ISSN-0208-5658] N91-21571
A discourse on sensitivity analysis for discretely-modeled structures
[NASA-TM-104065] N91-21577
Computer animation of NASTRAN displacements on IRIS 4D-series workstations: CANDI/ANIMATE postprocessing of NASHUA results
[DE91-008605] N91-21585
STARS: An integrated general-purpose finite element structural, aeroelastic, and aeroservoelastic analysis computer program
[NASA-TM-101709-REV] N91-21587
Structural characterization of the Ag/YBa2Cu3O(7-x) interface
[DE91-009112] N91-21907
STRUCTURAL DESIGN
High-pressure promoted combustion chamber
[NASA-CASE-MSC-21470-1] N91-21157
Model correlation and damage location for large space truss structures: Secant method development and evaluation
[NASA-CR-188102] N91-21213
Pre-integrated structures for Space Station Freedom
[NASA-TM-102780] N91-21214
Comparing structurally different views of a VLSI design
[PB91-111757] N91-21425
A criterion for the optimal design of multi-axis force sensors
[AD-A231014] N91-21500
Design and construction of a formed pulse circuit for a plasma centrifuge
[INPE-5161-RPE/639] N91-21895
STRUCTURAL FAILURE
Superconducting Super Collider silicon tracking subsystem research and development
[DE91-009227] N91-21862
STRUCTURAL MEMBERS
Structures of non-circular cross-section: Dynamic response due to vortex shedding
[ESDU-90036] N91-21103
STRUCTURAL PROPERTIES (GEOLOGY)
Volcanic-sedimentary sequence of the Greenstone Belt type in the Santa Rita or Goias elevation: An approach with TM-Landsat data
[INPE-5178-PRE/1647] N91-21610
STRUCTURAL STABILITY
Comparison of the post-buckling behavior of metallic and composite plates with centrally located cu touts
[PB91-118844] N91-21563
Superconducting Super Collider silicon tracking subsystem research and development
[DE91-009227] N91-21862
STRUCTURAL VIBRATION
An examination of anticipated g-jitter on space station and its effects on materials processes
[NASA-TM-103775] N91-21378
STUDENTS
An endorsement-based approach to student modeling for planner-controlled intelligent tutoring systems
[NASA-CR-188177] N91-21739
SUBDIVISIONS
Comparing structurally different views of a VLSI design
[PB91-111757] N91-21425
SUBMILLIMETER WAVES
From ground-based to space-borne sub-mm astronomy
[ESA-SP-314] N91-21986
Submillimeter observations with the Kuiper Airborne Observatory N91-21987
FIRST: Far Infrared and Submillimeter Space Telescope N91-21990
Sub-millimetric cosmology: From ground based to space observations N91-21991
Submillimeter astronomy and cosmological tests N91-21993
Submillimeter observations of extragalactic objects in the wavelength range 50 microns to 1 mm N91-21994
Extragalactic source counts, confusion limits and contributions to the background radiation in the sub-mm N91-21995
Japanese space programmes of IR and sub-mm astronomy N91-21997
The importance of submillimetre observations of radio quiet and radio loud AGN's N91-22000
The confusion limits to the sensitivity of submillimeter telescopes N91-22001
The galactic center at submillimeter and far-infrared wavelengths N91-22002
Late-type stars at far-infrared and sub-millimeter wavelengths N91-22006
The Swedish-ESO Submillimeter Telescope (SEST) N91-22008
The Smithsonian Astrophysical Observatory submillimeter wave telescope array N91-22009
Submillimeter astronomy and low mass star formation N91-22012
A highly collimated bipolar outflow in the core of OMC-1: CO submillimeter emission N91-22014
Requirements for SIS receivers in the 500-1000 GHz region N91-22015
Far-infrared heterodyne technology N91-22016
Development of components for submillimeter wave heterodyne radiometers at JPL N91-22017
LDR: A submillimeter great observatory N91-22018
A submillimeter mission for the 1990s: SMMM N91-22019
PRONAOS N91-22020
Interstellar chemistry and submillimetre astronomy N91-22021
First detection of C3H2 at sub-mm wavelengths N91-22022
Submillimeter water masers at 321 and 325 GHz N91-22023
Excitation of submillimeter water masers N91-22024
The submillimeter wave astronomy satellite N91-22025
FIR and sub-mm direct detection spectrometers for spaceborne astronomy N91-22026
Sub-mm direct photometry with large telescopes N91-22027
Submillimeter observations of interstellar dust N91-22028
The Caltech Submillimeter Observatory N91-22032
The Submillimeter Telescope (SMT) N91-22033
New Cologne acousto-optical spectrometer projects N91-22034
Submillimeter astronomy from the Antarctic plateau N91-22035
The OASI observatory in Antarctica N91-22036
Submillimetre observations of solar-system objects N91-22037
An active telescope for the sub-millimetre PRONAOS balloon-borne project N91-22038
Image quality of the PRONAOS telescope N91-22039
A flexible hybrid spectrometer for balloon borne and ground based (sub)millimeter wavelength astronomy N91-22043
SCUBA: A submillimetre camera N91-22044
Airborne heterodyne receiver for the range 600 GHz to 3,000 GHz N91-22047
Telescope technology for space-borne submillimeter astronomy N91-22049
MOSES: A proposed Swedish submillimeter satellite for combined astronomical and atmospheric observations N91-22050
The University of Tokyo-Norbeyama Radio Observatory submillimeter survey telescope N91-22051
Submillimetre photometry of comets N91-22052
SUBROUTINES
GEMPAK5. Part 1: GEMPAK5 programmer's guide, version 5.0
[NASA-TM-4261-PT-1] N91-21662
GEMPAK5. Part 2: GEMPLT programmer's guide, version 5.0
[NASA-TM-4261-PT-2] N91-21663
Signal parameter algorithms for trend analysis of digital data acquisition systems
[DE91-008171] N91-21749
SUBSONIC FLOW
A finite-difference, frequency-domain numerical scheme for the solution of the linearized unsteady Euler equations N91-21067
Computation of supersonic and low subsonic cascade flows using an explicit Navier-Stokes technique and the kappa-epsilon turbulence model N91-21072
Solution of three-dimensional afterbody flow using reduced Navier-Stokes equations N91-21093
STARS: An integrated general-purpose finite element structural, aeroelastic, and aeroservoelastic analysis computer program
[NASA-TM-101709-REV] N91-21587
SUBSONIC SPEED
Lift and rolling moment due to spoilers on wings at subsonic speeds
[ESDU-90030] N91-21129

SUBSTRATES
Nucleation and growth of diamond on Si, Cu and Au substrates
[AD-A231044] N91-21918
Kinetic aspects of lattice mismatch in molecular beam epitaxial growth on planar and patterned substrates
[AD-A231636] N91-21934
SUCTION
An experimental study of a three-dimensional swept-back wing with suction laminar-flow-control
[NAL-TR-1072] N91-21113
SULFUR
Hydrocarbon-fuel/combustion-chamber-liner materials compatibility
[NASA-CR-187104] N91-21307
Sources of volcanic aerosols: Petrologic and volcanological constraints N91-21644
SULFUR OXIDES
Adaptation of the Advanced Statistical Trajectory Regional Air Pollution (ASTRAP) model to the EPA VAX computer: Modifications and testing
[PB91-127720] N91-21631
SUNSPOTS
Spectral analysis of annual sunspot series: An update
[INPE-5207-PRE/1669] N91-22060
SUPERCOMPUTERS
Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics: Prospects of Computational Fluid Dynamics and Super Computers in Aerospace Science and Technology
[NAL-SP-13] N91-21379
Computer requirements for further CFD development N91-21380
CFD development present and prospects at NAL N91-21385
Parallelization techniques for a supercomputer with hierarchical memory architecture N91-21386
An automatic parallelization tool for sequential programs
[AD-A229972] N91-21771
SUPERCONDUCTING FILMS
Chemical spray pyrolysis of Tl-Ba-Ca-Cu-O high-T(sub c) superconductors for high-field bitter magnets N91-21212
Magnetic field induced broadening of the resistive transition in epitaxial films of YBa2Cu3O7 and Y2Ba4Cu8O16
[DE91-009825] N91-21916
SUPERCONDUCTING MAGNETS
A superconducting large-angle magnetic suspension N91-21191
Large gap magnetic suspension system N91-21201
SUPERCONDUCTING SUPER COLLIDER
Test results of a 90 MHz integrated circuit sixteen channel analog pipeline for SSC detector calorimetry
[DE91-009773] N91-21436
Superconducting Super Collider silicon tracking subsystem research and development
[DE91-009227] N91-21862
SUPERCONDUCTIVITY
Aerospace Applications of Magnetic Suspension Technology, part 1
[NASA-CP-10066-PT-1] N91-21188
A superconducting large-angle magnetic suspension N91-21191
Aerospace Applications of Magnetic Suspension Technology, part 2
[NASA-CP-10066-PT-2] N91-21203
Reduction in bearing size due to superconductors in magnetic bearings N91-21211
Chemical spray pyrolysis of Tl-Ba-Ca-Cu-O high-T(sub c) superconductors for high-field bitter magnets N91-21212
Superconducting Super Collider silicon tracking subsystem research and development
[DE91-009227] N91-21862
The series Bi2Sr2Ca(n-1) Cu(n)O(2n+4) (1 less than or equal to n less than or equal to 5): Phase stability and superconducting properties
[NASA-TM-103749] N91-21910
Early COBE results and superconducting cosmic strings N91-21989
SUPERCONDUCTORS
Spatial variations in ac susceptibility and microstructure for the YBa2Cu3O(7-x) superconductor and their correlation with room-temperature ultrasonic measurements
[NASA-TM-103787] N91-21553
FWP executive summaries: Basic energy sciences, materials sciences programs
[DE91-009223] N91-21826
Monolithic integration of semiconductor and superconductor components
[AD-A231464] N91-21930
The necessity for a DOD capability in superconducting electronics
[AD-A231553] N91-21931
SUPERCOOLING
Containerless processing of undercooled melts N91-21339
SUPERCRITICAL AIRFOILS
Blunt trailing edge analysis of supercritical airfoils by a Navier-Stokes code
[NAL-TR-1075-T] N91-21114
SUPERCRITICAL FLUIDS
Fundamental investigation of micelles and microemulsions in supercritical fluids
[AD-A231073] N91-21476
SUPERHETERODYNE RECEIVERS
Airborne heterodyne receiver for the range 600 GHz to 3,000 GHz N91-22047
SUPERLATTICES
Molecular beam epitaxial growth and electronic properties of GaP-on-Si (211) heterostructures, and of related systems
[AD-A231125] N91-21921
Optical NIPI device characterization
[AD-A231157] N91-21922
Critical behavior in magnetic superlattices
[AD-A231327] N91-21925
Theory of the electronic and optical properties of semiconductor heterostructures
[AD-A231438] N91-21929
SUPERPLASTICITY
Superplastic creep of eutectic tin-lead solder joints
[DE91-009074] N91-21586
SUPERSATURATION
In-situ x ray measurements of pit solutions during localized corrosion
[DE91-006916] N91-21295
SUPERSONIC COMBUSTION
Preliminary calibration of a generic scramjet combustor
[NASA-CR-187539] N91-21139
SUPERSONIC COMBUSTION RAMJET ENGINES
The 3D computation of single-expansion-ramp and scramjet nozzles N91-21092
A highly efficient engineering tool for three-dimensional scramjet flowfield and heat transfer computations N91-21098
Preliminary calibration of a generic scramjet combustor
[NASA-CR-187539] N91-21139
Nonintrusive nitric oxide density measurements in the NASA Langley arc-heated scramjet engine test facility
[AD-A231260] N91-21142
SUPERSONIC FLOW
Computation of supersonic and low subsonic cascade flows using an explicit Navier-Stokes technique and the kappa-epsilon turbulence model N91-21072
Finite element methods for integrated aerodynamic heating analysis
[NASA-CR-188079] N91-21101
Comparison study of the aerodynamic coefficients measured on models with circular or squared section and large elongation in supersonic flow
[ISL-R-125/89] N91-21106
STARS: An integrated general-purpose finite element structural, aeroelastic, and aeroservoelastic analysis computer program
[NASA-TM-101709-REV] N91-21587
SUPERSONIC NOZZLES
The 3D computation of single-expansion-ramp and scramjet nozzles N91-21092
SUPERSONIC TRANSPORTS
Span reduction effects on the flutter characteristics of arrow-wing supersonic transport configurations
[NASA-TP-3077] N91-21127
SUPERSYMMETRY
Indirect detection of heavy supersymmetric dark matter
[DE91-009669] N91-22055
SUPPORT SYSTEMS
Hot gas ingestion test results of a two-poster vectored thrust concept with flow visualization in the NASA Lewis 9- x 15-foot low speed wind tunnel
[NASA-TM-103258] N91-21116
Instructional Support System (ISS). Beginner's manual (Zenith 248 version only)
[PB91-127332] N91-21734
SUPPORTS
Mechanical strain isolator mount
[NASA-CASE-LAR-13580-1] N91-21541
Alignment positioning mechanism
[NASA-CASE-MSC-21502-1] N91-21543
Dynamic tube/support interaction in heat exchanger tubes
[DE91-006089] N91-21582
SURFACE ACOUSTIC WAVE DEVICES
Application of SAW technology in satellites for mobile services N91-21163
SAW technology for multicarrier demodulation in advanced payloads N91-21164
SURFACE DIFFUSION
Statistical properties of the sea surface sound dipole source
[AD-A230811] N91-21688
In-situ diffraction and imaging studies of heteroepitaxial growth of semi-conductors
[AD-A231568] N91-21932
SURFACE ENERGY
Drop coalescence studies N91-21375
SURFACE PROPERTIES
The nucleation and growth of polycrystalline silicon carbide
[DE91-008887] N91-21304
Vibrational frequencies for model silicates: Extensions beyond molecular properties
[DE91-008828] N91-21310
Statistical properties of the sea surface sound dipole source
[AD-A230811] N91-21688
SURFACE REACTIONS
Ultraviolet photoelectron spectra of gallium arsenide clusters
[AD-A224927] N91-21261
Scanning tunneling microscopy of reactive sites: Gasification of graphite by oxygen and hydrogen
[DE91-008569] N91-21274
Heat-rate improvements obtained with the use of enhanced tubes in surface condensers
[DE91-006565] N91-21449
SURFACE ROUGHNESS
Materials for aerospace vehicles friction drag reduction surfaces
[INPE-5188-PRE/1656] N91-21217
Application of the finite element method to random rough surface scattering with Neumann boundary conditions
[AD-A231583] N91-21420
SURFACE ROUGHNESS EFFECTS
Materials for aerospace vehicles friction drag reduction surfaces
[INPE-5188-PRE/1656] N91-21217
SURFACE TEMPERATURE
Heat transfer, velocity-temperature correlation, and turbulent shear stress from Navier-Stokes computations of shock wave/turbulent boundary layer interaction flows N91-21085
NCTM of liquids at high temperatures using polarization techniques N91-21345
Sources of volcanic aerosols: Petrologic and volcanological constraints N91-21644
SURFACE VEHICLES
Assessment of the absolute accuracy of long-baseline kinematic GPS positioning of a moving vehicle
[PB91-129379] N91-21125
A guide to ground vehicle operations on the airport
[AD-A231077] N91-21158
SURFACE WAVES
Interaction of surface waves and near surface currents
[AD-A231612] N91-21694
Experimental investigation of scattering of magnetostatic waves by surface acoustic waves
[DE91-009435] N91-21835
SURFACES
Numerical investigation of an internal layer in turbulent flow over a curved hill N91-21083
SURFACTANTS
Rheological properties, shape oscillations, and coalescence of liquid drops with surfactants N91-21357
Fundamental investigation of micelles and microemulsions in supercritical fluids
[AD-A231073] N91-21476
SURVEYS
Survey of NCAR user needs for visualization tools. A research report of the Digital/NCAR joint research project
[PB91-115444] N91-21154
Verification of parameters and morphological-environmental properties, by satellite imagery, for studies of coastal region planning
[INPE-5177-PRE/1646] N91-21606
Identification of information needs in a research institute
[INPE-5154-TDL/425] N91-21967
Technology transfer needs assessment, 1990
[PB91-125674] N91-21985
SUSPENDING (HANGING)
Torsional suspension system for testing space structures
[NASA-CASE-LAR-14149-1-SB] N91-21176

SWEPTBACK WINGS
An experimental study of a three-dimensional swept-back wing with suction laminar-flow-control
[NAL-TR-1072] N91-21113
SWIRLING
An experimental comparison of nonswirling and swirling flow in a circular-to-rectangular transition duct
[NASA-TM-104359] N91-21115
SWITCHES
High reliability megawatt transformer/rectifier
[NASA-CR-187079] N91-21430
SWITCHING CIRCUITS
A solid-state controllable power supply for a magnetic suspension wind tunnel N91-21199
SYNCHRONOUS PLATFORMS
On-orbit damage detection and health monitoring of large space trusses: Status and critical issues
[NASA-TM-104045] N91-21579
SYNCHROTRON RADIATION
The metrology of spherical shells using synchrotron x ray microtomography N91-21374
Advanced, time-resolved imaging techniques for electron-beam characterizations
[DE91-008587] N91-21865
Studies of synchrotron radiation emission from the NRL modified betatron accelerator
[AD-A231346] N91-21868
SYNCHROTRONS
The metrology of spherical shells using synchrotron x ray microtomography N91-21374
SYNOPTIC METEOROLOGY
North Atlantic weather regimes: A synoptic study of phase space
[NASA-CR-188162] N91-21673
SYNTAX
Implementation of a matrix theorem prover for propositional modal logic
[INPE-5124-RPE/629] N91-21743
An object oriented design and implementation of the IDEF(sub 0) essential model using Ada and an Ada based expert system
[AD-A230814] N91-21753
SYNTHESIS (CHEMISTRY)
Synthesis of imide/arylene ether copolymers for adhesives and composite matrices
[NASA-TM-104067] N91-21306
Imide/arylene ether block copolymers
[NASA-TM-104066] N91-21308
Integrated synthesis and post processing of silicon carbide and aluminum nitride
[AD-A230810] N91-21317
Synthesis, structure, and properties of segmented polyurethanes
[AD-A230966] N91-21319
High octane ethers from synthesis gas-derived alcohol
[DE91-008367] N91-21325
Containerless synthesis of interesting glasses N91-21340
Containerless synthesis of ceramic materials using microwave heating N91-21360
Theoretical investigation leading to energy storage in atomic and molecular systems
[AD-A231275] N91-21858
The series Bi2Sr2Ca(n-1) Cu(n)O(2n+4) (1 less than or equal to n less than or equal to 5): Phase stability and superconducting properties
[NASA-TM-103749] N91-21910
SYNTHETIC APERTURE RADAR
Design of a processing facility for synthetic aperture radar data at the Tromso ERS-1 ground station N91-21161
The single antenna interferometer
[DE91-007128] N91-21407
System and method for measuring ocean surface currents at locations remote from land masses using synthetic aperture radar
[NASA-CASE-NPO-17937-1-CU] N91-21621
SYNTHETIC FUELS
High octane ethers from synthesis gas-derived alcohol
[DE91-008367] N91-21325
SYSTEM IDENTIFICATION
Comparison of several system identification methods for flexible structures
[NASA-TM-104046] N91-21574
SYSTEMS ANALYSIS
AEOSS design guide for system analysis on Advanced Earth-Orbital Spacecraft Systems
[NASA-TM-100772] N91-21223
AEOSS runtime manual for system analysis on Advanced Earth-Orbital Spacecraft Systems
[NASA-TM-100773] N91-21224
Design of experiments to quantify communication satellite system performance
[PB91-129635] N91-21395
SYSTEMS ENGINEERING
An experimental study of exit flow patterns in a multistage compressor in rotating stall
[AD-A231353] N91-21143
Principle, advantages and disadvantages of a dc Current Transformer (DCCT)
[DIGEL-1990-5] N91-21431
Theory of semiconductor laser feedback instability
[DE91-008198] N91-21512
Physical property measurements on analog granites related to the joint verification experiment
[AD-A230571] N91-21650
A heterogeneous parallel programming capability
[AD-A229710] N91-21772
SYSTEMS INTEGRATION
Integrated flight/propulsion control system design based on a decentralized, hierarchical approach
[NASA-TM-103678] N91-21137
Pre-integrated structures for Space Station Freedom
[NASA-TM-102780] N91-21214
National plan for aviation human factors, volume 2
[PB91-100347] N91-21713
SYSTEMS MANAGEMENT
The development of perceptual/motor and cognitive performance measures under a high-G environment: A preliminary study
[AD-A231289] N91-21709

T

TAPE RECORDERS
Construction site Voice Operated Information System (VOIS) test
[AD-A231633] N91-21424
TARGET RECOGNITION
Transitive, anti-symmetric relational attributes in structural description matching with applications to radar target identification
[AD-A231318] N91-21417
TARGETS
A system for the real-time display of radar and video images of targets
[NASA-CR-188058] N91-21394
Calibration transfer target for a microwave radiometric profiling system
[PB91-129080] N91-21647
TASKS
Suppression of biodynamic interference in head-tracked teleoperation
[NASA-TM-103833] N91-21134
Acquisition and production of skilled behavior in dynamic decision-making tasks
[NASA-CR-188084] N91-21939
TAYLOR INSTABILITY
Singularities in water waves and Rayleigh-Taylor instability
[NASA-CR-187530] N91-21455
TECHNOLOGICAL FORECASTING
Far-infrared heterodyne technology N91-22016
Telescope technology for space-borne submillimeter astronomy N91-22049
TECHNOLOGY ASSESSMENT
Enhanced selectivity and detectability in absorption and fluorescence methods based on polarization modulation
[DE91-008926] N91-21279
Technology transfer needs assessment, 1990
[PB91-125674] N91-21985
TECHNOLOGY TRANSFER
Offshore technology R and D in space applications N91-21162
Construction site Voice Operated Information System (VOIS) test
[AD-A231633] N91-21424
NASA/DoD aerospace knowledge diffusion research project. Paper 9: Information intermediaries and the transfer of aerospace Scientific and Technical Information (STI). A report from the field
[NASA-TM-103384] N91-21959
Commercial space programs N91-21983
Technology transfer needs assessment, 1990
[PB91-125674] N91-21985
TECHNOLOGY UTILIZATION
Aerospace Applications of Magnetic Suspension Technology, part 1
[NASA-CP-10066-PT-1] N91-21188
Boundary layer study. Phase 4: Experimental validation test plan
[AD-A231342] N91-21481
The indirect economic effects of the European Space Agency programs
[ESA-BR-63] N91-21975
TECTONICS
Solid earth science in the 1990s. Volume 2: Panel reports
[NASA-TM-4256-VOL-2] N91-21590
Report of the panel on plate motion and deformation, section 2 N91-21591
Report of the panel on the land surface: Process of change, section 5 N91-21594
TELECOMMUNICATION
Transportation telecommunications
[PB91-123257] N91-21399
An empirical study of combining communicating processes in a parallel discrete event simulation
[AD-A230982] N91-21412
Using the USU ionospheric model to predict radio propagation through a simulated ionosphere
[AD-A231599] N91-21423
Excision techniques in direct sequence spread spectrum communication systems
[AD-A231290] N91-21763
TELEMETRY
Cloud classification of DMSP visible and IR imagery using physical and textural features
[AD-A231186] N91-21680
Physiology data acquisition system description
[AD-A231088] N91-21706
TELEOPERATORS
Suppression of biodynamic interference in head-tracked teleoperation
[NASA-TM-103833] N91-21134
Method and apparatus for positioning a robotic end effector
[NASA-CASE-MSC-21476-1] N91-21542
TELEROBOTICS
Aerobrake assembly with minimum Space Station accommodation
[NASA-TM-102778] N91-21183
TELESCOPES
The confusion limits to the sensitivity of submillimeter telescopes N91-22001
SOFIA: The Stratospheric Observatory For Infrared Astronomy N91-22003
Large-scale (CII) 158 micron emission of the Galaxy observed by a balloon-borne telescope N91-22004
PRONAOS N91-22020
Sub-mm direct photometry with large telescopes N91-22027
The James Clerk Maxwell telescope N91-22031
The Submillimeter Telescope (SMT) N91-22033
Submillimeter astronomy from the Antarctic plateau N91-22035
An active telescope for the sub-millimetre PRONAOS balloon-borne project N91-22038
Image quality of the PRONAOS telescope N91-22039
The University of Tokyo-Norbeyama Radio Observatory submillimeter survey telescope N91-22051
TEMPERATE REGIONS
Using the USU ionospheric model to predict radio propagation through a simulated ionosphere
[AD-A231599] N91-21423
Dynamics of oceanic motions
[AD-A231135] N91-21693
TEMPERATURE DISTRIBUTION
Deep overheating of thin bodies in flight with very low-angled trajectory
[ISL-R-126/89] N91-21107
A high-speed spatial (linear) scanning pyrometer: A tool for diagnostics, temperature mapping, and property determinations at high temperatures N91-21361
The University of Tokyo-Norbeyama Radio Observatory submillimeter survey telescope N91-22051
TEMPERATURE EFFECTS
Measurement of residual stresses by x ray diffraction near simulated heat affected zones in austenitic stainless steels
[DE91-008874] N91-21289
High temperature deformation of silicon
[DE91-009102] N91-21305
Frequency response of a supported thermocouple wire: Effects of axial conduction
[NASA-CR-188101] N91-21489
Flexible diaphragm-extreme temperature usage
[NASA-CASE-MSC-20797-2] N91-21494
HITCAN for actively cooled hot-composite thermostructural analysis
[NASA-TM-103750] N91-21562
Inhalation toxicology. 11: The effect of elevated temperature on carbon monoxide toxicity
[AD-A231185] N91-21708
On the temperature corrections for QED operators in the superstrong magnetic field
[DE91-619627] N91-21822
The James Clerk Maxwell telescope N91-22031
The Submillimeter Telescope (SMT) N91-22033
TEMPERATURE GRADIENTS
Sinusoidal response of a thin viscoplastic plate with severe temperature gradient
[AD-A230938] N91-21588

TEMPERATURE MEASUREMENT
Thermophysical property measurements in electromagnetic levitators N91-21344
NCTM of liquids at high temperatures using polarization techniques N91-21345
A high-speed spatial (linear) scanning pyrometer: A tool for diagnostics, temperature mapping, and property determinations at high temperatures N91-21361
Tank gauging apparatus and method [NASA-CASE-MSC-21059-3] N91-21495
TEMPERATURE PROFILES
Calibration transfer target for a microwave radiometric profiling system [PB91-129080] N91-21647
TEMPORAL DISTRIBUTION
Temporal variation of areas occupied by aquatic macrophytes in the Tucurui reservoir through Landsat/TM data [INPE-5174-PRE/1643] N91-21607
Power spectra of internal gravity waves [AD-A231596] N91-21659
Laboratory evaluation and application of microwave absorption properties under simulated conditions for planetary atmospheres [NASA-CR-188096] N91-22057
TENSILE DEFORMATION
Tractable high performance polymers [AD-A231072] N91-21320
TENSILE PROPERTIES
Mechanical behavior of fiber reinforced SiC/RBSN ceramic matrix composites: Theory and experiment [NASA-TM-103688] N91-21243
Material properties of silicon carbide fibers with continuously applied sol-gel alumina coatings [AD-A230825] N91-21256
TENSILE STRENGTH
Modelling of the impact response of fibre-reinforced composites [OUEL-1863/90] N91-21244
Effect of strain rate on the through-thickness elastic properties of woven laminates N91-21245
Flat tensile specimen design for advanced composites [NASA-CR-185261] N91-21252
Mechanical strength and thermophysical properties of PM212: A high temperature self-lubricating powder metallurgy composite [NASA-TM-103694] N91-21302
TENSILE TESTS
Analysis of failure in woven carbon/epoxy laminates under quasi-static and impact loading N91-21248
TERRAIN
Spot 1: Imagery in geologic mapping: A comparative study with several remote sensing products in the Curaca River Valley, Bahia [INPE-5136-PRE/1624] N91-21608
Design and development of the terrain information extraction system [AD-A231166] N91-21623
The hemispheric eighth mesh terrain elevation and geography data sets [AD-A231592] N91-21624
TEST EQUIPMENT
Advanced expander test bed program [NASA-CR-187082] N91-21234
Experimental laboratory system to generate high frequency test environments [DE91-008252] N91-21583
Physiology data acquisition system description [AD-A231088] N91-21706
TEST FACILITIES
Simulation of nap-of-the-Earth flight in helicopters [NASA-TM-102830] N91-21131
Nonintrusive nitric oxide density measurements in the NASA Langley arc-heated scramjet engine test facility [AD-A231260] N91-21142
AEDC focal plane array test capability [AD-A230846] N91-21408
TEXTURES
Micromechanisms of friction in electrogalvanized sheet steel with emphasis on the role of texture [DE91-009113] N91-21290
Verification of parameters and morphological-environmental properties, by satellite imagery, for studies of coastal region planning [INPE-5177-PRE/1646] N91-21606
Cloud classification of DMSP visible and IR imagery using physical and textural features [AD-A231186] N91-21680
THEMATIC MAPPERS (LANDSAT)
Registration of windfall damage in the eastern Hunsrueck Plateau (Fed. Republic of Germany) utilizing LANDSAT TM data: A landscape-ecological analysis for practical forestry [DLR-FB-90-31] N91-21601
Remote sensing estimation of total chlorophyll pigment distribution in Barra Bonita Reservoir [INPE-5202-PRE/1664] N91-21603
TM/LANDSAT-5 multispectral reflectance for the remote sensing of the condition of bean crop vigor [INPE-5184-PRE/1652] N91-21604
Verification of parameters and morphological-environmental properties, by satellite imagery, for studies of coastal region planning [INPE-5177-PRE/1646] N91-21606
Discrimination of lithological units in the lower Valley of the Curaca River (Bahia), through enhancement of digital processing of MSS-LANDSAT-3 data [INPE-5120-RPE/627] N91-21613
Spectral responses of soybean and cotton from Landsat/TM digital data [INPE-5179-PRE/1648] N91-21614
THEMATIC MAPPING
Evaluation of TM/LANDSAT-5 bands in the discrimination of wheat and beam crops [INPE-5204-PRE/1666] N91-21602
Temporal variation of areas occupied by aquatic macrophytes in the Tucurui reservoir through Landsat/TM data [INPE-5174-PRE/1643] N91-21607
Spot 1: Imagery in geologic mapping: A comparative study with several remote sensing products in the Curaca River Valley, Bahia [INPE-5136-PRE/1624] N91-21608
Use of direct expansion for estimation of soybean and corn areas through multispectral and temporal LANDSAT/TM data [INPE-5180-PRE/1649] N91-21609
Volcanic-sedimentary sequence of the Greenstone Belt type in the Santa Rita or Goias elevation: An approach with TM-Landsat data [INPE-5178-PRE/1647] N91-21610
Comparative analysis of AVHRR/NOAA and TM/LANDSAT data in the delimitation of savanna/forest contact area: Preliminary results [INPE-5200-RPE/639] N91-21611
Characterization of antropic action in the Mearim (MA) middle-low valley through LANDSAT/TM imagery [INPE-5075-PRE/1594] N91-21620
Evaluation of indigenous areas utilizing TM/LANDSAT data [INPE-5173-PRE/1642] N91-21636
THEOREM PROVING
Implementation of a matrix theorem prover for propositional modal logic [INPE-5124-RPE/629] N91-21743
THEOREMS
Neural network representation and learning of mappings and their derivatives N91-21780
THEORETICAL PHYSICS
Theoretical studies in elementary particle physics [DE91-009543] N91-21851
THERMAL ANALYSIS
Flight motor set 360T010 (STS-31R). Volume 1: System overview [NASA-CR-184104] N91-21231
Thermomechanics tasks and applications [DLR-MITT-90-14] N91-21254
The University of Tokyo-Norbeyama Radio Observatory submillimeter survey telescope N91-22051
THERMAL BOUNDARY LAYER
Experimental study of boundary layer transition on a heated flat plate [NASA-TM-103779] N91-21061
Transverse flow gas lens [AD-A231366] N91-21878
THERMAL BUCKLING
Thermal buckling and postbuckling of symmetrically laminated composite plates [NASA-CR-188030] N91-21560
THERMAL CONDUCTIVITY
The effect of microstructure on the thermal conductivity of ZnS/diamond composites [AD-A231349] N91-21928
THERMAL DIFFUSIVITY
A high temperature thermal diffusivity determination procedure for solids and liquids N91-21377
THERMAL EMISSION
Submillimeter observations of interstellar dust N91-22028
THERMAL ENVIRONMENTS
Heats of explosion at low pressures, 2 [AD-A231020] N91-21328
THERMAL EXPANSION
Thermal buckling and postbuckling of symmetrically laminated composite plates [NASA-CR-188030] N91-21560
Dynamic tube/support interaction in heat exchanger tubes [DE91-006089] N91-21582
Optical switching and optical logic in a thermally expanding Si etalon [AD-A230706] N91-21870
THERMAL MAPPING
Supervision of peat stockpiles using aerial thermography [DE91-752966] N91-21622
THERMAL PLASMAS
An unusual case of meter wave type-3 bursts leading millimeter-wave bursts [INPE-5140-PRE/1628] N91-22064
THERMAL PROTECTION
One way to reduce thermal effects in a piezoelectric pressure transducer mounted in the combustion chamber of a C.I. engine [ISVR-TR-189] N91-21487
New materials and new techniques for imaging of long wavelength IR radiation [AD-A231086] N91-21877
THERMAL RADIATION
Thermal transport studies of optical coatings, interfaces and surfaces by thermal diffusion-wave interferometry [AD-A231607] N91-21879
THERMAL RESISTANCE
New materials and new techniques for imaging of long wavelength IR radiation [AD-A231086] N91-21877
The effect of microstructure on the thermal conductivity of ZnS/diamond composites [AD-A231349] N91-21928
THERMAL STABILITY
Constant-current stagnation-point film-anemometer probe [AD-A231048] N91-21501
THERMOCHEMISTRY
Very high temperature chemistry: Science justification for containerless experimentation in space N91-21334
Estimates of thermochemical relaxation lengths behind normal shock waves relevant to manned lunar and Mars return missions, the aeroassist flight experiment, and Mars entry [NASA-TM-102879] N91-21471
THERMOCOUPLES
Frequency response of a supported thermocouple wire: Effects of axial conduction [NASA-CR-188101] N91-21489
THERMODYNAMIC EFFICIENCY
One way to reduce thermal effects in a piezoelectric pressure transducer mounted in the combustion chamber of a C.I. engine [ISVR-TR-189] N91-21487
THERMODYNAMIC PROPERTIES
Engineering property limitations of structural ceramics and ceramic composites above 1600 C [DE91-009105] N91-21311
Thermodynamic properties and crystallization kinetics at high liquid undercooling N91-21343
PALM2D: A nonlinear finite element program for the coupled thermomechanical response of solids in two dimensions [DE91-008423] N91-21584
Atmospheric environment for space shuttle (STS-38) launch [NASA-TM-103530] N91-21633
Atomic layer epitaxy of silicon, silicon/germanium, and silicon carbide via extraction/exchange processes [AD-A231348] N91-21927
THERMODYNAMICS
Vibrational frequencies for model silicates: Extensions beyond molecular properties [DE91-008828] N91-21310
NCTM of liquids at high temperatures using polarization techniques N91-21345
THERMOELECTRIC GENERATORS
Post-encapsulation plutonia reduction for Galileo and Ulysses GPHS modules: The Module Reduction and Monitoring Facility (MRMF) [DE91-008131] N91-21861
THERMOGRAPHY
Infrared thermography for the qualitative aerodynamic study of a slender body [ISL-R-122/89] N91-21104
Supervision of peat stockpiles using aerial thermography [DE91-752966] N91-21622
THERMOMECHANICAL TREATMENT
Thermomechanics tasks and applications [DLR-MITT-90-14] N91-21254
THERMONUCLEAR REACTIONS
Recent developments in Monte Carlo techniques [DE91-009750] N91-21808
Characterization of the plasma-switch interaction in the LBL HIF ion source [DE91-009479] N91-21902

THERMOPHYSICAL PROPERTIES
Real-time measurement of materials properties at high temperatures by laser produced plasmas N91-21342
Thermophysical property measurements in electromagnetic levitators N91-21344
NCTM of liquids at high temperatures using polarization techniques N91-21345
Some considerations for various positioning systems and their science capabilities N91-21372
THICKNESS
Sinusoidal response of a thin viscoplastic plate with severe temperature gradient
[AD-A230938] N91-21588
THIN FILMS
Dip coating of sol-gels
[DE91-007571] N91-21872
New materials and new techniques for imaging of long wavelength IR radiation
[AD-A231086] N91-21877
Growth and characterization of thin films of Y2O3, La2O3 and La2CuO4
[AD-A231046] N91-21919
Preparation and characterization of Iron(III) oxide films by an novel spray pyrolysis method
[AD-A231047] N91-21920
In-situ diffraction and imaging studies of heteroepitaxial growth of semi-conductors
[AD-A231568] N91-21932
THIN PLATES
Sinusoidal response of a thin viscoplastic plate with severe temperature gradient
[AD-A230938] N91-21588
THIN WALLS
A method for the geometrically nonlinear analysis of compressively loaded prismatic composite structures
[NASA-CR-184846] N91-21561
THORIUM ALLOYS
Double 4f-collapse in Ce(0.9-x)Yb(x)Th(0.1)
[DE91-619752] N91-21908
THREADS
An economic analysis of counterfeit threaded fasteners in the construction industry
[AD-A231492] N91-21551
THREE DIMENSIONAL FLOW
Compressible flows with periodic vortical disturbances around lifting airfoils
[NASA-TM-103742] N91-21060
Thoughts on the chimera method of simulation of three-dimensional viscous flow N91-21063
Computational study of three dimensional viscous flow through a turbine cascade using a multi-domain spectral technique N91-21066
A finite-difference, frequency-domain numerical scheme for the solution of the linearized unsteady Euler equations N91-21067
A pressure based method for the solution of viscous incompressible turbomachinery flows N91-21078
Implicit solution of three-dimensional internal turbulent flows N91-21082
Solution of three-dimensional afterbody flow using reduced Navier-Stokes equations N91-21093
Finite element methods for integrated aerodynamic heating analysis
[NASA-CR-188079] N91-21101
CFD for hypersonic propulsion
[NASA-TM-103791] N91-21447
Finite element methods of analysis for 3D inviscid compressible flows
[NASA-CR-186271] N91-21463
General three-dimensional disturbances to inviscid Couette flow
[DE91-009593] N91-21474
THREE DIMENSIONAL MODELS
An efficient correspondence based algorithm for 2D and 3D model based recognition
[AD-A231406] N91-21767
THRUST VECTOR CONTROL
Static thrust-vectoring performance of nonaxisymmetric convergent-divergent nozzles with post-exit yaw vanes
[NASA-TP-3085] N91-21059
Hot gas ingestion test results of a two-poster vectored thrust concept with flow visualization in the NASA Lewis 9- x 15-foot low speed wind tunnel
[NASA-TM-103258] N91-21116
THUNDERSTORMS
Convective scale dynamics
[AD-A231567] N91-21683
TIME
Hypercube clock synchronization
[DE91-009222] N91-21774
TIME DEPENDENCE
Process integration: Process change and batch processes
[ESDU-90033] N91-21390
Stability analysis of time-dependent transport algorithms
[DE91-009170] N91-21750
Numerical analysis and computation of nonlinear partial differential equations from applied mathematics
[AD-A231188] N91-21806
Recent JET results and future prospects
[DE91-005474] N91-21897
TIME LAG
A time delay controller for magnetic bearings N91-21205
TIME MARCHING
A multiblock multigrid three-dimensional Euler equation solver
[NASA-TM-103424] N91-21795
TIME MEASUREMENT
Navigation Experiment NAVEX: Measurement and performance of the spaceborne clocks
[ESA-TT-1209] N91-21823
TIME OPTIMAL CONTROL
Very high speed holographic message routing for parallel machines
[AD-A230965] N91-21499
TIME SHARING
Noise effects upon a simple timing channel
[AD-A230818] N91-21726
TIN ALLOYS
Superplastic creep of eutectic tin-lead solder joints
[DE91-009074] N91-21586
TISSUES (BIOLOGY)
Spiral vane bioreactor
[NASA-CASE-MSC-21361-1] N91-21701
TITANIUM ALLOYS
Controlling fundamentals in high-energy high-rate pulsed power materials processing of powdered tungsten, titanium aluminides, and copper-graphite composites
[AD-A230900] N91-21298
TITRATION
Potentiometric titration of gold, platinum, and some other precious metals
[DE91-008989] N91-21276
TOKAMAK DEVICES
Sawteeth and their stabilization in JET
[DE91-005459] N91-21882
High performance H modes in JET
[DE91-005488] N91-21883
Comparison of beryllium and graphite first-walls in JET
[DE91-005489] N91-21884
High density regimes and beta limits in JET
[DE91-005490] N91-21885
ICRF heating in reactor grade plasmas
[DE91-005491] N91-21886
Transport in auxiliary-heated, hot-ion H-mode and L-mode discharges in the DIII-D tokamak
[DE91-008924] N91-21887
Role of the edge electric field and microturbulence in the L-H transition
[DE91-008925] N91-21888
Recent JET results and future prospects
[DE91-005474] N91-21897
Some observations concerning alpha instabilities and driven tokamak reactors
[DE91-008628] N91-21898
Laser diagnostics for plasma turbulence
[DE91-009377] N91-21899
TOMOGRAPHY
The metrology of spherical shells using synchrotron x ray microtomography N91-21374
Nondestructive imaging of materials microstructure using x ray tomographic microscopy
[DE91-008505] N91-21554
Numerical recovery of certain discontinuous electrical conductivities
[NASA-CR-187543] N91-21800
TOPOGRAPHY
Proposed methodology for the study of urban environment and space structure in metropolitan area
[INPE-5203-PRE/1665] N91-21216
Report of the panel on plate motion and deformation, section 2 N91-21591
Report of the panel on the land surface: Process of change, section 5 N91-21594
Report of the panel on international programs N91-21599
National Geophysical Data Center: Programs and services (25th anniversary 1965-1990)
[PB91-123356] N91-21960
TORNADOES
Gust front/wind shift detection algorithm for the terminal Doppler weather radar
[DOT/FAA/NR-91/4] N91-21671
Features of the Raleigh tornadic storm based on analysis of damage
[AD-A231601] N91-21684
TOROIDAL PLASMAS
Observation of parallel viscosity in the CHS heliotron/torsatron
[NIFS-70] N91-21891
Kinetic stability of field-reversed configurations
[DE91-009530] N91-21901
TOROIDS
Spectral analysis of the heliotron field with the toroidal harmonic function in a study of the structure of built-in divertor
[NIFS-71] N91-21892
TORQUE
A criterion for the optimal design of multi-axis force sensors
[AD-A231014] N91-21500
TORSION
Torsional suspension system for testing space structures
[NASA-CASE-LAR-14149-1-SB] N91-21176
Ground-based testing of the dynamics of flexible space structures using band mechanisms
[NASA-CR-188154] N91-21576
TOTAL OZONE MAPPING SPECTROMETER
Analysis of error in TOMS total ozone as a function of orbit and attitude parameters
[NASA-CR-4361] N91-21670
TOXICITY
Inhalation toxicology. 11: The effect of elevated temperature on carbon monoxide toxicity
[AD-A231185] N91-21708
TOXICOLOGY
Inhalation toxicology. 11: The effect of elevated temperature on carbon monoxide toxicity
[AD-A231185] N91-21708
TRACKING (POSITION)
Suppression of biodynamic interference in head-tracked teleoperation
[NASA-TM-103833] N91-21134
Sliding mode control of magnetic suspensions for precision pointing and tracking applications N91-21193
Efficient approaches for report/cluster correlation in multitarget tracking systems
[AD-A231589] N91-21421
Method and apparatus for positioning a robotic end effector
[NASA-CASE-MSC-21476-1] N91-21542
Satellite altimetry for naval oceanography
[AD-A231081] N91-21691
TRACKING FILTERS
Kalman filter tracking of a reflective target using forward looking infrared measurements and laser illumination
[AD-A231196] N91-21524
TRADEOFFS
Requirements and trade-off studies in satellite mechanical architecture
[INPE-5186-PRE/1654] N91-21219
TRAFFIC CONTROL
Non-airborne conflicts: The causes and effects of runway transgressions
[NASA-CR-177372] N91-21121
TRAILING EDGES
An experimental investigation of circulation control flow fields using holographic interferometry
[NASA-CR-166482] N91-21459
TRAINING EVALUATION
A conceptual model of the performance of the United States Air Force flight training program
[AD-A230881] N91-21711
TRAJECTORIES
Adaptation of the Advanced Statistical Trajectory Regional Air Pollution (ASTRAP) model to the EPA VAX computer: Modifications and testing
[PB91-127720] N91-21631
TRAJECTORY ANALYSIS
Possibilities of trajectory modification
[ISL-CO-209/90] N91-21151
TRAJECTORY CONTROL
Entry vehicle performance analysis and atmospheric guidance algorithm for precision landing on Mars
[AD-A231585] N91-21228
TRAJECTORY PLANNING
Experiments in thrusterless robot locomotion control for space applications
[NASA-CR-188027] N91-21528
TRANSDUCERS
A criterion for the optimal design of multi-axis force sensors
[AD-A231014] N91-21500
Frequency response calibration of recess-mounted pressure transducers
[NASA-TM-104031] N91-21834
FY 1989 acoustics research
[AD-A231499] N91-21840
TRANSFER FUNCTIONS
Neural network representation and learning of mappings and their derivatives N91-21780

Optimal Hankel-norm approximation and rational function models using impulse response data
[AD-A231317] N91-21839

TRANSFER ORBITS
A stochastic approach to the problem of spacecraft optimal manoeuvres
[INPE-5192-PRE/1660] N91-21171
Aerobrake assembly with minimum Space Station accommodation
[NASA-TM-102778] N91-21183

TRANSFORMATIONS (MATHEMATICS)
The fast Hartley transform
[AD-A230370] N91-21400
Rapidly convergent algorithms for nonsmooth optimization
[AD-A231110] N91-21756

TRANSFORMERS
High reliability megawatt transformer/rectifier
[NASA-CR-187079] N91-21430
Principle, advantages and disadvantages of a dc Current Transformer (DCCT)
[DIGEL-1990-5] N91-21431

TRANSIENT RESPONSE
A discourse on sensitivity analysis for discretely-modeled structures
[NASA-TM-104065] N91-21577

TRANSISTOR AMPLIFIERS
Estimating power amplifier large signal gain
[AD-A230823] N91-21437

TRANSISTORS
Single board system for fuzzy inference N91-21784

TRANSITION FLOW
Transition and turbulence
[ESA-TT-1219] N91-21465
Investigation of highly excited CO transitions in OMC-1 N91-22013

TRANSITION METALS
First principles theory of the interaction of hydrogen with surfaces and bulk of transition metals
[AD-A231248] N91-21285
Interplay between local environment effect and electronic structure properties in close packed structures
[DE91-008506] N91-21915
Host materials for 4d(sup N) and 5d(sup N) transition-metal ions
[AD-A231606] N91-21933

TRANSITION TEMPERATURE
Monolithic integration of semiconductor and superconductor components
[AD-A231464] N91-21930

TRANSLATIONAL MOTION
Connection space reduction mechanism
[NASA-CASE-GSC-13220-1] N91-21525

TRANSMISSION EFFICIENCY
Queueing models for token and slotted ring networks
[NASA-CR-188091] N91-21791

TRANSMISSION LOSS
Real time assisted tracking for low Earth orbit satellites
[INPE-5157-PRE/1636] N91-21170

TRANSMISSIONS (MACHINE ELEMENTS)
Advanced rotorcraft transmission program
[NASA-TM-103276] N91-21531
Effects of gear box vibration and mass imbalance on the dynamics of multi-stage gear transmissions
[NASA-TM-103695] N91-21534

TRANSMITTANCE
Serrated circular apertures: Optical Fourier transforms and fractal analysis
[AD-A230834] N91-21874

TRANSMITTER RECEIVERS
Phase-lock-loop application for fiber optic receiver
[NASA-TM-102776] N91-21435

TRANSONIC FLOW
Transonic cascade flow calculations using non-periodic C-type grids N91-21071
Solution of three-dimensional afterbody flow using reduced Navier-Stokes equations N91-21093
Comparison study of the aerodynamic coefficients measured on models with circular or squared section and large elongation in supersonic flow
[ISL-R-125/89] N91-21106
Prediction of unsteady transonic separated flow for missile applications
[AD-A231259] N91-21120

TRANSONIC FLUTTER
Span reduction effects on the flutter characteristics of arrow-wing supersonic transport configurations
[NASA-TP-3077] N91-21127

TRANSONIC SPEED
Blunt trailing edge analysis of supercritical airfoils by a Navier-Stokes code
[NAL-TR-1075-T] N91-21114

TRANSONIC WIND TUNNELS
Description and evaluation of an interference assessment for a slotted-wall wind tunnel
[NASA-CR-4352] N91-21155

TRANSPARENCE
Research studies on extreme ultraviolet and soft x ray lasers
[AD-A231033] N91-21523
Growth and characterization of thin films of Y2O3, La2O3 and La2CuO4
[AD-A231046] N91-21919

TRANSPONDERS
Application of SAW technology in satellites for mobile services N91-21163

TRANSPORT PROPERTIES
Electronic and ionic transport in processable conducting polymers
[AD-A231293] N91-21321
Some observations concerning alpha instabilities and driven tokamak reactors
[DE91-008628] N91-21898

TRANSPORT THEORY
Levelling of microprofiles in electrodeposition
[DE91-009083] N91-21297
Stability analysis of time-dependent transport algorithms
[DE91-009170] N91-21750
Transport via moments of quantum distribution functions
[AD-A231182] N91-21821

TRANSPORTATION
Transportation telecommunications
[PB91-123257] N91-21399

TRAVELING IONOSPHERIC DISTURBANCES
Norwegian studies of plasma modifications around spacecraft and how these affect the vehicle potential N91-21166

TREES (PLANTS)
Dynamics of vegetation and soils of oak/saw palmetto scrub after fire: Observations from permanent transects
[NASA-TM-103817] N91-21635

TREND ANALYSIS
Signal parameter algorithms for trend analysis of digital data acquisition systems
[DE91-008171] N91-21749

TRIANGULATION
Generation and use of unstructured grids for turbomachinery calculations N91-21064

TRIBOLOGY
Effective cleaning of oil-protected bearing steel examined by XPS analysis. Part 1: Cleaning by solvents and alkaline cleaners
[NAL-TR-1074] N91-21538
Tribological performance and deformation of sputter-deposited MoS2 solid lubricant films during sliding wear and indentation contact
[AD-A231003] N91-21547

TRIGONOMETRIC FUNCTIONS
Determination of pitch and roll angles with respect to a point on earth surface
[INPE-5206-PRE/1668] N91-21215

TROPICAL REGIONS
Discrimination of lithological units in the lower Valley of the Curaca River (Bahia), through enhancement of digital processing of MSS-LANDSAT-3 data
[INPE-5120-RPE/627] N91-21613
Historical evidence for a connection between volcanic eruptions and climate change N91-21642
Nonlinear symmetric instability and oscillations in the tropical atmosphere N91-21674
Data assimilation and wind-stress error correction in a forced tropical ocean model N91-21687

TROPICAL STORMS
ONR tropical cyclone motion research initiative: Field experiment summary
[AD-A231152] N91-21679

TROPOSPHERE
Radio wave propagation modeling, prediction and assessment
[AGARD-AG-326] N91-21404
Nonlinear symmetric instability and oscillations in the tropical atmosphere N91-21674

TROPOSPHERIC WAVES
Radio wave propagation modeling, prediction and assessment
[AGARD-AG-326] N91-21404

TRUNCATION ERRORS
Bayesian analysis of constrained parameter and truncated data problems
[AD-A231080] N91-21810

TRUSSES
Model correlation and damage location for large space truss structures: Secant method development and evaluation
[NASA-CR-188102] N91-21213
Pre-integrated structures for Space Station Freedom
[NASA-TM-102780] N91-21214
Overcenter collet space station truss fastener
[NASA-CASE-MSC-21504-1] N91-21221
On-orbit damage detection and health monitoring of large space trusses: Status and critical issues
[NASA-TM-104045] N91-21579

TUBE GRIDS
Grid pulse generator
[DIGEL-1990-6] N91-21863

TUBES
Dynamic tube/support interaction in heat exchanger tubes
[DE91-006089] N91-21582

TUNABLE LASERS
Research studies on extreme ultraviolet and soft x ray lasers
[AD-A231033] N91-21523

TUNGSTEN
Controlling fundamentals in high-energy high-rate pulsed power materials processing of powdered tungsten, titanium aluminides, and copper-graphite composites
[AD-A230900] N91-21298

TUNNEL DIODES
Requirements for SIS receivers in the 500-1000 GHz region N91-22015

TURBINE PUMPS
Modeling of rolling element bearing mechanics
[NASA-CR-188045] N91-21530
Evaluation of bearing configurations using the single bearing tester in liquid nitrogen
[NASA-TM-103527] N91-21532

TURBOCOMPRESSORS
An experimental study of exit flow patterns in a multistage compressor in rotating stall
[AD-A231353] N91-21143

TURBOFAN ENGINES
Study of bird ingestions into small inlet area aircraft turbine engines
[DOT/FAA/CT-90/13] N91-21122
A preliminary evaluation of an F100 engine parameter estimation process using flight data
[NASA-TM-4216] N91-21446

TURBOGENERATORS
Historical development of the windmill
[NASA-CR-4337] N91-21625

TURBOMACHINERY
Computational Fluid Dynamics Symposium on Aeropropulsion
[NASA-CP-3078] N91-21062
Generation and use of unstructured grids for turbomachinery calculations N91-21064
Simulation of turbomachinery flows N91-21069
Transonic cascade flow calculations using non-periodic C-type grids N91-21071
Computation of supersonic and low subsonic cascade flows using an explicit Navier-Stokes technique and the kappa-epsilon turbulence model N91-21072
A pressure based method for the solution of viscous incompressible turbomachinery flows N91-21078
Grid generation strategies for turbomachinery configurations N91-21091
A modal aeroelastic analysis scheme for turbomachinery blading
[NASA-CR-187089] N91-21138
Critical speeds and forced response solutions for active magnetic bearing turbomachinery, part 1 N91-21209
Critical speeds and forced response solutions for active magnetic bearing turbomachinery, part 2 N91-21210
Modeling of rolling element bearing mechanics
[NASA-CR-188045] N91-21530

TURBULENCE
Transonic cascade flow calculations using non-periodic C-type grids N91-21071
The PDF method for turbulent combustion N91-21080
Numerical investigation of an internal layer in turbulent flow over a curved hill N91-21083
An experimental study of a three-dimensional swept-back wing with suction laminar-flow-control
[NAL-TR-1072] N91-21113
Using a microgravity environment to probe wave turbulence N91-21355
Estimations of ABL fluxes and other turbulence parameters from Doppler lidar data
[NASA-CR-188053] N91-21665
High performance computing for large eddy simulations: Today and tomorrow
[AD-A231220] N91-21758
The stucture of molecular clouds: New questions N91-22011

TURBULENCE MODELS
Computational Fluid Dynamics Symposium on Aeropropulsion
[NASA-CP-3078] N91-21062

Implicit solution of three-dimensional internal turbulent flows N91-21082
Numerical investigation of an internal layer in turbulent flow over a curved hill N91-21083
Computation of turbulent high speed mixing layers using a two-equation turbulence model N91-21084
Heat transfer, velocity-temperature correlation, and turbulent shear stress from Navier-Stokes computations of shock wave/turbulent boundary layer interaction flows N91-21085
Wave models for turbulent free shear flows N91-21086
Blunt trailing edge analysis of supercritical airfoils by a Navier-Stokes code [NAL-TR-1075-T] N91-21114

TURBULENT BOUNDARY LAYER
Experimental study of boundary layer transition on a heated flat plate [NASA-TM-103779] N91-21061
Heat transfer, velocity-temperature correlation, and turbulent shear stress from Navier-Stokes computations of shock wave/turbulent boundary layer interaction flows N91-21085
Practical methods to evaluate the friction drag coefficient of a projectile in free flight [ISL-R-123/89] N91-21105
Graduate fellowship in hypersonics [AD-A231263] N91-21478

TURBULENT FLOW
Pressure algorithm for elliptic flow calculations with the PDF method N91-21081
Implicit solution of three-dimensional internal turbulent flows N91-21082
Numerical investigation of an internal layer in turbulent flow over a curved hill N91-21083
Computational modelling of dump combustors flowfield N91-21096
Velocity measurements in a turbulent trailing vortex and their application to BWI noise prediction [NASA-CR-188083] N91-21100
Turbulent separated flow past a backward-facing step: A critical evaluation of two-equation turbulence models [NASA-CR-187532] N91-21451
Probability distribution functions in turbulent convection [NASA-CR-187519] N91-21453
Characteristic eddy decomposition of turbulence in a channel [NASA-TM-100065] N91-21470
Variational method in the statistical theory of turbulence [AD-A231621] N91-21484

TURBULENT MIXING
Computation of turbulent high speed mixing layers using a two-equation turbulence model N91-21084

TWO BODY PROBLEM
A perturbation solution of the main problem in artificial satellite theory [AD-A231560] N91-21227

TWO DIMENSIONAL FLOW
Finite difference form of the compressible boundary layer equations in generalized curvilinear coordinates [AD-A231386] N91-21483

TWO DIMENSIONAL MODELS
Modeling failure and reliability in new-generation devices [AD-A230998] N91-21439
PALM2D: A nonlinear finite element program for the coupled thermomechanical response of solids in two dimensions [DE91-008423] N91-21584
An efficient correspondence based algorithm for 2D and 3D model based recognition [AD-A231406] N91-21767

TYPE 3 BURSTS
An unusual case of meter wave type-3 bursts leading millimeter-wave bursts [INPE-5140-PRE/1628] N91-22064

U

U.S.S.R.
The energy source rocket of the Soviet Union [AD-A224938] N91-21229
Environment fact finding mission report [PB91-130369] N91-21628

ULTRAHIGH FREQUENCIES
GaAs monolithic RF modules for SARSAT distress beacons [NASA-TM-104338] N91-21184
L-band antenna array with integrated phase shifters [ESA-TT-1215] N91-21405

ULTRASONIC CLEANING
Effective cleaning of oil-protected bearing steel examined by XPS analysis. Part 1: Cleaning by solvents and alkaline cleaners [NAL-TR-1074] N91-21538

ULTRASONIC TESTS
Spatial variations in ac susceptibility and microstructure for the YBa2Cu3O(7-x) superconductor and their correlation with room-temperature ultrasonic measurements [NASA-TM-103787] N91-21553

ULTRASONICS
Growth and characterization of thin films of Y2O3, La2O3 and La2CuO4 [AD-A231046] N91-21919

ULTRAVIOLET LASERS
High current photoemission with 10 picosecond UV pulses [DE91-009439] N91-21515
Research studies on extreme ultraviolet and soft x ray lasers [AD-A231033] N91-21523

ULTRAVIOLET RADIATION
UV cured epoxy resin coatings [DE91-008180] N91-21303
High current photoemission with 10 picosecond UV pulses [DE91-009439] N91-21515
Research studies on extreme ultraviolet and soft x ray lasers [AD-A231033] N91-21523
In vitro photoreactivation of transforming DNA of Bacillus subtilis spores after irradiation by ultraviolet light [ESA-TT-1210] N91-21699

ULTRAVIOLET SPECTRA
Ultraviolet photoelectron spectra of gallium arsenide clusters [AD-A224927] N91-21261
Time-resolved extreme-ultraviolet spectroscopy of laser-produced plasmas originating at the parylene layer of microballon targets [DE91-009378] N91-21900

ULTRAVIOLET SPECTROSCOPY
Time-resolved extreme-ultraviolet spectroscopy of laser-produced plasmas originating at the parylene layer of microballon targets [DE91-009378] N91-21900

ULYSSES MISSION
Post-encapsulation plutonia reduction for Galileo and Ulysses GPHS modules: The Module Reduction and Monitoring Facility (MRMF) [DE91-008131] N91-21861

UNDERGROUND EXPLOSIONS
Stress-strain gage measurements on a Nevada Test Site (NTS) event using pairs of triple foil gages [DE91-005061] N91-21497

UNDERGROUND STRUCTURES
UHF model simulation of detecting voids in a dielectric medium using HF-VHF airborne short-pulse radar [AD-A231495] N91-21418

UNDERWATER ACOUSTICS
Analysis of 200 Hz CW tone propagation signal recorded during the September 1987 VLA experiment [AD-A231053] N91-21414
High resolution beamforming on large aperture vertical line arrays: Processing synthetic data [AD-A231054] N91-21415
A 200 Hz matched field processing on the September 1987 VLA data set [AD-A231096] N91-21692
Transient solutions from scattered fields in a waveguide [AD-A231124] N91-21838
Optimal Hankel-norm approximation and rational function models using impulse response data [AD-A231317] N91-21839
FY 1989 acoustics research [AD-A231499] N91-21840

UNDERWATER VEHICLES
Performance of small thrusters and propulsion systems [AD-A231482] N91-21241

UNIQUENESS THEOREM
Existence and uniqueness results for problems arising in connection with the incompressible Navier-Stokes equations [FFA-TN-1989-43] N91-21468

UNIVERSE
Can non-Gaussian fluctuations for structure formation arise from inflation [DE91-009458] N91-21655

UNIVERSITY PROGRAM
The 1991/92 graduate student researchers program, including the underrepresented minority focus component [NASA-TM-101801] N91-22065

UNIX (OPERATING SYSTEM)
Tools for monitoring and controlling distributed applications [NASA-CR-188034] N91-21770

UNSTEADY AERODYNAMICS
A modal aeroelastic analysis scheme for turbomachinery blading [NASA-CR-187089] N91-21138
STARS: An integrated general-purpose finite element structural, aeroelastic, and aeroservoelastic analysis computer program [NASA-TM-101709-REV] N91-21587

UNSTEADY FLOW
Compressible flows with periodic vortical disturbances around lifting airfoils [NASA-TM-103742] N91-21060
Numerical solutions of 2-D multi-stage rotor/stator unsteady flow interactions N91-21070
Cost-effective accurate coarse-grid method for highly convective multidimensional unsteady flows N91-21075
Prediction of unsteady transonic separated flow for missile applications [AD-A231259] N91-21120
A modal aeroelastic analysis scheme for turbomachinery blading [NASA-CR-187089] N91-21138
Singularities in water waves and Rayleigh-Taylor instability [NASA-CR-187530] N91-21455

UPPER ATMOSPHERE
A search for episodic increases in upper atmospheric water vapor as evidence of an extraterrestrial source [AD-A231598] N91-21660

UPPER SURFACE BLOWING
Method and apparatus for detecting laminar flow separation and reattachment [NASA-CASE-LAR-13952-2-SB] N91-21472

URANUS (PLANET)
A search for stellar occultations by Uranus, Neptune, Pluto, and their satellites: 1990-1999 [NASA-CR-188146] N91-22053

USER MANUALS (COMPUTER PROGRAMS)
MATGRID, a program for generation of C-H and C-O topology grids around wing/body configurations: User's guide [FFA-TN-1991-03] N91-21110
User's manual for SLAB: An atmospheric dispersion model for denser-than-air-releases [DE91-008443] N91-21638
GEMPAK5 user's guide, version 5.0 [NASA-TM-4260] N91-21661
GEMPAK5. Part 1: GEMPAK5 programmer's guide, version 5.0 [NASA-TM-4261-PT-1] N91-21662
GEMPAK5. Part 2: GEMPLT programmer's guide, version 5.0 [NASA-TM-4261-PT-2] N91-21663
VM-CMS tutorial [DE91-009444] N91-21725
Instructional Support System (ISS). Beginner's manual (Zenith 248 version only) [PB91-127332] N91-21734
Geographic information systems: A primer [AD-A231465] N91-21974

USER REQUIREMENTS
Implementation of FFT and pulse compression routines on the SPT frequency domain array processor [AD-A231320] N91-21443
Decision support environment for concurrent engineering requirements [AD-A230899] N91-21555
A toolkit for designing user interfaces [AD-A231558] N91-21723
A remote visual interface tool for simulation control and display [AD-A231019] N91-21754
Technology transfer needs assessment, 1990 [PB91-125674] N91-21985

UTILITIES
Survey on electron beam processing technologies [DE91-759126] N91-21866

V

V/STOL AIRCRAFT
Integrated flight/propulsion control design for a STOVL aircraft using H-infinity control design techniques [NASA-TM-104340] N91-21140

VACUUM APPARATUS
Broad-beam, high current, metal ion implantation facility [DE91-009329] N91-21291
Construction of flowing afterglow apparatus [AD-A231062] N91-21855

VACUUM MELTING
TEMPUS: First results N91-21350
VACUUM SPECTROSCOPY
Finding a single molecule in a haystack: Laser spectroscopy of solids from square root of (N to N) =1
[AD-A230910] N91-21521
VALENCE
Dependence of the photorefractive properties of KTa(1-x)Nb(x)O3:Cu,V on Cu valence state concentration
[AD-A230954] N91-21917
VALLEYS
Characterization of antropic action in the Mearim (MA) middle-low valley through LANDSAT/TM imagery
[INPE-5075-PRE/1594] N91-21620
VAPOR DEPOSITION
Modified chemical vapor deposition of gradient index lenses
[AD-A230989] N91-21281
The nucleation and growth of polycrystalline silicon carbide
[DE91-008887] N91-21304
VAPOR PHASES
Center for low-gravity fluid mechanics and transport phenomena
[NASA-CR-188048] N91-21452
Construction of flowing afterglow apparatus
[AD-A231062] N91-21855
VAPORIZING
Supercritical microgravity droplet vaporization N91-21354
VARIABILITY
Variability of the Sq focus position in the South American continent
[INPE-4740-PRE/1415] N91-21652
VARIATIONAL PRINCIPLES
Variational method in the statistical theory of turbulence
[AD-A231621] N91-21484
Deterministic and stochastic sensitivity in computational structural mechanics
[ISSN-0208-5658] N91-21571
VARIATIONS
Stochastic and deterministic fluctuations in stimulated Brillouin scattering
[AD-A230988] N91-21522
VECTOR PROCESSING (COMPUTERS)
CFD simulation on a massively parallel processor N91-21387
VEGETATION
Comparative analysis of AVHRR/NOAA and TM/LANDSAT data in the delimitation of savanna/forest contact area: Preliminary results
[INPE-5200-RPE/639] N91-21611
Dynamics of vegetation and soils of oak/saw palmetto scrub after fire: Observations from permanent transects
[NASA-TM-103817] N91-21635
Evaluation of indigenous areas utilizing TM/LANDSAT data
[INPE-5173-PRE/1642] N91-21636
VEGETATIVE INDEX
TM/LANDSAT-5 multispectral reflectance for the remote sensing of the condition of bean crop vigor
[INPE-5184-PRE/1652] N91-21604
Temporal variation of areas occupied by aquatic macrophytes in the Tucurui reservoir through Landsat/TM data
[INPE-5174-PRE/1643] N91-21607
VELOCITY MEASUREMENT
Velocity measurements in a turbulent trailing vortex and their application to BWI noise prediction
[NASA-CR-188083] N91-21100
Slant hot-wire inclination measurement using dual laser beams
[NAL-TR-1078] N91-21491
VENTILATION
Ventilation loss and pressurization in the NASA launch/entry suit: Potential for heat stress
[NASA-CR-188075] N91-21719
VENUS (PLANET)
Data analysis for the Pioneer-Venus electric field detector
[NASA-CR-188099] N91-22056
VENUS ATMOSPHERE
Data analysis for the Pioneer-Venus electric field detector
[NASA-CR-188099] N91-22056
VERTICAL ORIENTATION
Satellite-derived moisture-bogusing profiles for the Northwest Pacific Ocean
[AD-A231058] N91-21690
A 200 Hz matched field processing on the September 1987 VLA data set
[AD-A231096] N91-21692
VERY HIGH FREQUENCIES
Comparison of 14 decibels versus 20 decibels desired to undesired signal protection ratios
[DOT/FAA/CT-TN89/69] N91-21833
VERY LARGE ARRAY (VLA)
NGC3309: An S-shaped radio galaxy in a nearby cluster
[INPE-5143-PRE/1631] N91-22054
VERY LARGE SCALE INTEGRATION
Comparing structurally different views of a VLSI design
[PB91-111757] N91-21425
A demonstration of CMOS VLSI circuit prototyping in support of the site facility using the 1.2 micron standard cell library developed by National Security Agency
[NASA-CR-188014] N91-21426
Single board system for fuzzy inference N91-21784
VERY LONG BASE INTERFEROMETRY
The Smithsonian Astrophysical Observatory submillimeter wave telescope array N91-22009
VERY LONG BASELINE ARRAY (VLBA)
The Smithsonian Astrophysical Observatory submillimeter wave telescope array N91-22009
VERY LOW FREQUENCIES
Comparative study of VLF signals in the sub-Antarctic region
[INPE-5165-TDL/426] N91-21406
VHSIC (CIRCUITS)
VHSIC Hardware Description Language (VHDL) benchmark suite
[AD-A231276] N91-21761
VIBRATION
A modal aeroelastic analysis scheme for turbomachinery blading
[NASA-CR-187089] N91-21138
Critical speeds and forced response solutions for active magnetic bearing turbomachinery, part 2 N91-21210
Improved fits for the vibrational and rotational constants of many states of nitrogen and oxygen
[AD-A229996] N91-21263
Closed-form solutions for linear regulator design of mechanical systems including optimal weighting matrix selection
[NASA-TM-104052] N91-21572
VIBRATION DAMPING
Control issues of microgravity vibration isolation N91-21192
Microgravity vibration isolation: An optimal control law for the one-dimensional case N91-21206
Active vibration absorber for CSI evolutionary model: Design and experimental results
[NASA-TM-104048] N91-21578
VIBRATION EFFECTS
Effects of gear box vibration and mass imbalance on the dynamics of multi-stage gear transmissions
[NASA-TM-103695] N91-21534
VIBRATION ISOLATORS
Magnetic suspension systems for space applications N91-21189
Advanced magnetic suspensions for vibration isolation and fast-attitude control of space-based generic pointing mounts N91-21190
Active vibration absorber for CSI evolutionary model: Design and experimental results
[NASA-TM-104048] N91-21578
VIBRATION MODE
Dynamic response of a hammerhead launch vehicle wind-tunnel model
[NASA-TM-104050] N91-21177
Effects of gear box vibration and mass imbalance on the dynamics of multi-stage gear transmissions
[NASA-TM-103695] N91-21534
VIBRATION TESTS
Experimental laboratory system to generate high frequency test environments
[DE91-008252] N91-21583
VIBRATIONAL SPECTRA
Vibrational frequencies for model silicates: Extensions beyond molecular properties
[DE91-008828] N91-21310
VIDEO EQUIPMENT
A system for the real-time display of radar and video images of targets
[NASA-CR-188058] N91-21394
VIRTUAL MEMORY SYSTEMS
VM-CMS tutorial
[DE91-009444] N91-21725
VISCOPLASTICITY
Sinusoidal response of a thin viscoplastic plate with severe temperature gradient
[AD-A230938] N91-21588
VISCOSITY
Surface tension and viscosity from damped free oscillations of viscous droplets N91-21346
Observation of parallel viscosity in the CHS heliotron/torsatron
[NIFS-70] N91-21891
VISCOUS FLOW
Thoughts on the chimera method of simulation of three-dimensional viscous flow N91-21063
Computational study of three dimensional viscous flow through a turbine cascade using a multi-domain spectral technique N91-21066
Choice of velocity variables for complex flow computation N91-21076
A pressure based method for the solution of viscous incompressible turbomachinery flows N91-21078
Solution of three-dimensional afterbody flow using reduced Navier-Stokes equations N91-21093
Finite element methods for integrated aerodynamic heating analysis
[NASA-CR-188079] N91-21101
Investigation of nose bluntness and angle of attack effects on slender bodies in viscous hypertension flows
[NASA-CR-188153] N91-21117
CFD for hypersonic propulsion
[NASA-TM-103791] N91-21447
Boundary layer study. Phase 4: Experimental validation test plan
[AD-A231342] N91-21481
VISORS
A field evaluation of the compatibility of the protective integrated hood mask with ANVIS night vision goggles
[AD-A230237] N91-21718
VISUAL CONTROL
A remote visual interface tool for simulation control and display
[AD-A231019] N91-21754
VISUAL PERCEPTION
Probability estimates of cloud-obscured line-of-sight
[AD-A231151] N91-21678
VOICE COMMUNICATION
Construction site Voice Operated Information System (VOIS) test
[AD-A231633] N91-21424
VOIDS
UHF model simulation of detecting voids in a dielectric medium using HF-VHF airborne short-pulse radar
[AD-A231495] N91-21418
VOLATILITY
Modified chemical vapor deposition of gradient index lenses
[AD-A230989] N91-21281
VOLCANOES
Report of the panel on volcanology, section 4 N91-21593
Climatic impact of volcanic eruptions N91-21643
Sources of volcanic aerosols: Petrologic and volcanological constraints N91-21644
Volcanic aerosols: Chemistry, evolution, and effects N91-21645
Volcanic effects on climate N91-21646
VOLCANOLOGY
Solid earth science in the 1990s. Volume 2: Panel reports
[NASA-TM-4256-VOL-2] N91-21590
Report of the panel on volcanology, section 4 N91-21593
Volcanic-sedimentary sequence of the Greenstone Belt type in the Santa Rita or Goias elevation: An approach with TM-Landsat data
[INPE-5178-PRE/1647] N91-21610
Volcanism-Climate Interactions
[NASA-CP-10062] N91-21641
Historical evidence for a connection between volcanic eruptions and climate change N91-21642
Climatic impact of volcanic eruptions N91-21643
Sources of volcanic aerosols: Petrologic and volcanological constraints N91-21644
Volcanic aerosols: Chemistry, evolution, and effects N91-21645
Volcanic effects on climate N91-21646
VOLTAGE CONTROLLED OSCILLATORS
Phase-lock-loop application for fiber optic receiver
[NASA-TM-102776] N91-21435
VOLTAGE CONVERTERS (DC TO DC)
High reliability megawatt transformer/rectifier
[NASA-CR-187079] N91-21430
VOLUME
Volumetric measurement of tank volume
[NASA-CASE-MSC-21500-1] N91-21493
VORTEX BREAKDOWN
Vortex bursting over a unit area aspect ratio delta wing using vortex paneling methods
[AD-A231026] N91-21119
VORTEX FILAMENTS
Convergence of the point vortex method for the 3-D Euler equations
[AD-A231285] N91-21479

VORTEX SHEDDING
Velocity measurements in a turbulent trailing vortex and their application to BWI noise prediction
[NASA-CR-188083] N91-21100
Structures of non-circular cross-section: Dynamic response due to vortex shedding
[ESDU-90036] N91-21103
VORTEX SHEETS
Vortex bursting over a unit area aspect ratio delta wing using vortex paneling methods
[AD-A231028] N91-21119
VORTICES
Compressible flows with periodic vortical disturbances around lifting airfoils
[NASA-TM-103742] N91-21060
A finite-difference, frequency-domain numerical scheme for the solution of the linearized unsteady Euler equations N91-21067
The direct simulation of high-speed mixing-layers without and with chemical heat release N91-21095
Vortex bursting over a unit area aspect ratio delta wing using vortex paneling methods
[AD-A231028] N91-21119
Uniform high order spectral methods for one and two dimensional Euler equations
[NASA-CR-187535] N91-21456
A simple model vortex flow past a slender elliptic cone at incidence
[RAE-TM-AERO-2197] N91-21460
Characteristic eddy decomposition of turbulence in a channel
[NASA-TM-100065] N91-21470
Large eddy simulation: Where do we stand
[AD-A230835] N91-21657
Dynamics of oceanic motions
[AD-A231135] N91-21693
High performance computing for large eddy simulations: Today and tomorrow
[AD-A231220] N91-21758
VORTICITY EQUATIONS
Research in nonlinear water waves
[AD-A231205] N91-21477
VULNERABILITY
Methodology development for the verification and validation of flight critical systems software, phase 1
[AD-A229932] N91-21735

W

WAFERS
Silicon hybrid Wafer Scale Integration (WSI) used to fabricate a Hilbert transform integrated circuit module
[AD-A230605] N91-21428
WAKES
Numerical solutions of 2-D multi-stage rotor/stator unsteady flow interactions N91-21070
Vortex bursting over a unit area aspect ratio delta wing using vortex paneling methods
[AD-A231028] N91-21119
WALL TEMPERATURE
Infrared thermography for the qualitative aerodynamic study of a slender body
[ISL-R-122/89] N91-21104
WALLS
Description and evaluation of an interference assessment for a slotted-wall wind tunnel
[NASA-CR-4352] N91-21155
WARFARE
The oceanic cloudy atmosphere: Measurement requirements and solution options
[AD-A231121] N91-21677
Interaction of strategic defenses with crisis stability
[DE91-009002] N91-21814
Strategic defense requirements for progressive applications
[DE91-009045] N91-21816
Strategic defense system: Stable design and adequate testing must precede decision to deploy
[AD-A230864] N91-21820
WARM FRONTS
Analysis of three icing test flights reaching the aircraft-referred icing degree severe
[DLR-FB-90-34] N91-21123
WATER
Drop coalescence studies N91-21375
WATER INJECTION
Theoretical investigation of the injection and evaporation of water in a hydrogen/oxygen steam generator
[DLR-FB-90-20] N91-21938
WATER MASERS
Submillimeter water masers at 321 and 325 GHz N91-22023
Excitation of submillimeter water masers N91-22024
WATER QUALITY
Environment fact finding mission report
[PB91-130369] N91-21628
WATER RESOURCES
Using climate model output to assess the impacts of climate change on water resources
[DE91-004542] N91-21637
WATER TUNNEL TESTS
Transition and turbulence
[ESA-TT-1219] N91-21465
WATER VAPOR
Wet atmospheric generation apparatus
[NASA-CASE-MFS-28177-1] N91-21496
A search for episodic increases in upper atmospheric water vapor as evidence of an extraterrestrial source
[AD-A231598] N91-21660
Theoretical investigation of the injection and evaporation of water in a hydrogen/oxygen steam generator
[DLR-FB-90-20] N91-21938
Submillimeter water masers at 321 and 325 GHz N91-22023
WATER WAVES
Singularities in water waves and Rayleigh-Taylor instability
[NASA-CR-187530] N91-21455
Research in nonlinear water waves
[AD-A231205] N91-21477
Interaction of surface waves and near surface currents
[AD-A231612] N91-21694
WAVE DIFFRACTION
Optical scattering methods applicable to drops and bubbles N91-21358
WAVE EQUATIONS
Compressible flows with periodic vortical disturbances around lifting airfoils
[NASA-TM-103742] N91-21060
Singularities in water waves and Rayleigh-Taylor instability
[NASA-CR-187530] N91-21455
Calculation of thickness and charge noise radiated by a rotor in forward flight
[ISL-R-119/89] N91-21831
Physics without physical constants
[DE91-619576] N91-21935
WAVE FRONTS
Generation and use of unstructured grids for turbomachinery calculations N91-21064
Unstructured grid generation using the distance function N91-21065
WAVE INTERACTION
Using a microgravity environment to probe wave turbulence N91-21355
WAVE PROPAGATION
Unstructured grid generation using the distance function N91-21065
Wave models for turbulent free shear flows N91-21086
Using a microgravity environment to probe wave turbulence N91-21355
Long-term performance and propagation measurements on single and tandem digital microwave transmission links. Volume 1: Analysis of measurement data
[PB91-129643] N91-21396
Radio wave propagation modeling, prediction and assessment
[AGARD-AG-326] N91-21404
Analysis of 200 Hz CW tone propagation signal recorded during the September 1987 VLA experiment
[AD-A231053] N91-21414
High resolution beamforming on large aperture vertical line arrays: Processing synthetic data
[AD-A231054] N91-21415
Calibration transfer target for a microwave radiometric profiling system
[PB91-129080] N91-21647
FY 1989 acoustics research
[AD-A231499] N91-21840
WAVE SCATTERING
Experimental investigation of scattering of magnetostatic waves by surface acoustic waves
[DE91-009435] N91-21835
WAVEFORMS
The fast Hartley transform
[AD-A230370] N91-21400
WAVEGUIDES
Transient solutions from scattered fields in a waveguide
[AD-A231124] N91-21838
SCUBA: A submillimetre camera N91-22044
WEAPON SYSTEMS
Notes on space, satellites, and survivability
[DE91-009229] N91-21226
Decision support environment for concurrent engineering requirements
[AD-A230899] N91-21555
Requirements for progressive strategic defenses
[DE91-008997] N91-21812
Near-term boost-phase defense sensitivities
[DE91-008999] N91-21813
Interaction of strategic defenses with crisis stability
[DE91-009002] N91-21814
Strategic defense requirements for progressive applications
[DE91-009045] N91-21816
WEAR
Effective cleaning of oil-protected bearing steel examined by XPS analysis. Part 1: Cleaning by solvents and alkaline cleaners
[NAL-TR-1074] N91-21538
Tribological performance and deformation of sputter-deposited MoS2 solid lubricant films during sliding wear and indentation contact
[AD-A231003] N91-21547
WEATHER
North Atlantic weather regimes: A synoptic study of phase space
[NASA-CR-188162] N91-21673
WEATHER FORECASTING
Stratus surge prediction along the Central California coast
[PB91-129239] N91-21668
Tropical cyclone track objective aids for the microcomputer: PCLM, XTRP, PCHP
[AD-A230851] N91-21675
Convective scale dynamics
[AD-A231567] N91-21683
WEATHERING
Correlative studies between spectral responses and weathering indices of alternate weathered cover
[INPE-5176-PRE/1645] N91-21618
WEIGHT REDUCTION
Reduction in bearing size due to superconductors in magnetic bearings N91-21211
WEIGHTING FUNCTIONS
Closed-form solutions for linear regulator design of mechanical systems including optimal weighting matrix selection
[NASA-TM-104052] N91-21572
A linear quadratic regulator weight selection algorithm for robust pole assignment
[AD-A230598] N91-21737
WEIGHTLESSNESS
Volumetric measurement of tank volume
[NASA-CASE-MSC-21500-1] N91-21493
Tank gauging apparatus and method
[NASA-CASE-MSC-21059-3] N91-21495
WELD TESTS
An evaluation of GTAW-P versus GTA welding of alloy 718
[NASA-TM-103529] N91-21287
WELDED JOINTS
An evaluation of GTAW-P versus GTA welding of alloy 718
[NASA-TM-103529] N91-21287
WELDING
Strength of polymer interfaces
[AD-A230839] N91-21318
Resistance seam welding thin copper foils
[DE91-008988] N91-21535
WHEAT
Evaluation of TM/LANDSAT-5 bands in the discrimination of wheat and beam crops
[INPE-5204-PRE/1666] N91-21602
Spectral characteristics of agricultural crops and yield
[INPE-5125-RPE/630] N91-21619
WHISKERS (CRYSTALS)
A simple test for thermomechanical evaluation of ceramic fibers
[NASA-TM-103767] N91-21309
WHISTLERS
Experimental study project of plasma waves and turbulences
[INPE-5127-RPE/632] N91-21896
WHITE NOISE
Frequency response calibration of recess-mounted pressure transducers
[NASA-TM-104031] N91-21834
WIND (METEOROLOGY)
Structures of non-circular cross-section: Dynamic response due to vortex shedding
[ESDU-90036] N91-21103
Registration of windfall damage in the eastern Hunsrueck Plateau (Fed. Republic of Germany) utilizing LANDSAT TM data: A landscape-ecological analysis for practical forestry
[DLR-FB-90-31] N91-21601
WIND EFFECTS
Structures of non-circular cross-section: Dynamic response due to vortex shedding
[ESDU-90036] N91-21103

WIND MEASUREMENT
A simple, analytical, axisymmetric microburst model for downdraft estimation
[NASA-TM-104053] N91-21132
WIND PROFILES
A simple, analytical, axisymmetric microburst model for downdraft estimation
[NASA-TM-104053] N91-21132
Atmospheric environment for space shuttle (STS-38) launch
[NASA-TM-103530] N91-21633
WIND SHEAR
A simple, analytical, axisymmetric microburst model for downdraft estimation
[NASA-TM-104053] N91-21132
Data assimilation and wind-stress error correction in a forced tropical ocean model N91-21687
WIND TUNNEL APPARATUS
Propulsion simulator for magnetically-suspended wind tunnel models N91-21198
A solid-state controllable power supply for a magnetic suspension wind tunnel N91-21199
Constant-current stagnation-point film-anemometer probe
[AD-A231048] N91-21501
WIND TUNNEL MODELS
Hot-bench simulation of the active flexible wing wind-tunnel model
[NASA-TM-102758] N91-21144
Dynamic response of a hammerhead launch vehicle wind-tunnel model
[NASA-TM-104050] N91-21177
Propulsion simulator for magnetically-suspended wind tunnel models N91-21198
WIND TUNNEL TESTS
Low speed wind tunnel investigation of propeller slipstream aerodynamic effects on different nacelle/wing combinations. Part 2: Propeller slipstream flow field surveys (velocity components, dynamic, total and static pressure distributions) at zero angle of attack and high power
[FFA-TN-1990-24-PT-2] N91-21109
Wind tunnel test of a propeller working in a low Reynolds number range
[NAL-TR-1071] N91-21112
An experimental study of a three-dimensional swept-back wing with suction laminar-flow-control
[NAL-TR-1072] N91-21113
Span reduction effects on the flutter characteristics of arrow-wing supersonic transport configurations
[NASA-TP-3077] N91-21127
Hot-bench simulation of the active flexible wing wind-tunnel model
[NASA-TM-102758] N91-21144
Possibilities of trajectory modification
[ISL-CO-209/90] N91-21151
Results of the HHC wind tunnel tests, 1986 - 1988
[DLR-FB-90-42] N91-21152
Description and evaluation of an interference assessment for a slotted-wall wind tunnel
[NASA-CR-4352] N91-21155
Dynamic response of a hammerhead launch vehicle wind-tunnel model
[NASA-TM-104050] N91-21177
Propulsion simulator for magnetically-suspended wind tunnel models N91-21198
CFD research and systems in Kawasaki Heavy Industries and its future prospects N91-21382
Constant-current stagnation-point film-anemometer probe
[AD-A231048] N91-21501
WIND TUNNELS
Propulsion simulator for magnetically-suspended wind tunnel models N91-21198
NASA Ames aerospace systems directorate research
[NASA-TM-103844] N91-22066
WIND TURBINES
Historical development of the windmill
[NASA-CR-4337] N91-21625
WINDMILLS (WINDPOWERED MACHINES)
Historical development of the windmill
[NASA-CR-4337] N91-21625
WINDPOWERED GENERATORS
Historical development of the windmill
[NASA-CR-4337] N91-21625
WING SPAN
Span reduction effects on the flutter characteristics of arrow-wing supersonic transport configurations
[NASA-TP-3077] N91-21127
WINGS
Lift and rolling moment due to spoilers on wings at subsonic speeds
[ESDU-90030] N91-21129
WINTER
Experiment on rapidly intensifying cyclones over the Atlantic
[AD-A231377] N91-21682
WINTER 1990 hydrographics data report: CTD station profiles, sections, nutrients, SAIL, January - February 1990
[DE91-008286] N91-21686
WIRE
Frequency response of a supported thermocouple wire: Effects of axial conduction
[NASA-CR-188101] N91-21489
WORKING FLUIDS
Cooling of in-situ propellant rocket engines for Mars mission
[NASA-TM-103729] N91-21233
Heat tube device
[NASA-CASE-KSC-11395-1-CU] N91-21473
WORKLOADS (PSYCHOPHYSIOLOGY)
Suppression of biodynamic interference in head-tracked teleoperation
[NASA-TM-103833] N91-21134
National plan for aviation human factors, volume 1
[PB91-100339] N91-21712
Human performance concerns for the TRACKWOLF system
[AD-A231359] N91-21722
WORKSTATIONS
A system for the real-time display of radar and video images of targets
[NASA-CR-188058] N91-21394
Satellite cloud analyses: A nowcasting capability for the US Navy's TESS(3)
[AD-A231120] N91-21676
A toolkit for designing user interfaces
[AD-A231558] N91-21723
The IBM RISC System/6000 and linear algebra operations
[DE91-009221] N91-21805

X

X RAY ABSORPTION
XANES (X ray Absorption Near Edge Structure) investigation of cerium as an inhibitor for Al alloys
[DE91-005542] N91-21293
X RAY LASERS
X ray laser holography of biological microstructures
[DE91-008732] N91-21488
Research studies on extreme ultraviolet and soft x ray lasers
[AD-A231033] N91-21523
X RAY SOURCES
The metrology of spherical shells using synchrotron x ray microtomography N91-21374
X RAY SPECTRA
Double 4f-collapse in Ce(0.9-x)Yb(x)Th(0.1)
[DE91-619752] N91-21908
X RAY SPECTROSCOPY
In-situ x ray measurements of pit solutions during localized corrosion
[DE91-006916] N91-21295
Effective cleaning of oil-protected bearing steel examined by XPS analysis. Part 1: Cleaning by solvents and alkaline cleaners
[NAL-TR-1074] N91-21538
X RAYS
Radiographic instrumentation for DPM experiments N91-21373
The metrology of spherical shells using synchrotron x ray microtomography N91-21374
Nondestructive imaging of materials microstructure using x ray tomographic microscopy
[DE91-008505] N91-21554
Analysis and interpretation of diffuse x-ray emission using data from the Einstein satellite
[NASA-CR-187988] N91-21728
Characteristic x rays method for detecting cold fusion
[DE91-619982] N91-21890
XENON
A discussion of the xenon laser intensity as a function of pump rate
[DE91-009225] N91-21506

Y

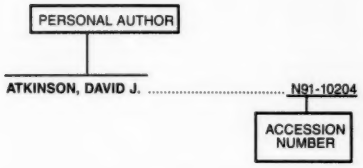
YAW
Static thrust-vectoring performance of nonaxisymmetric convergent-divergent nozzles with post-exit yaw vanes
[NASA-TP-3085] N91-21059
Frictional and retarding forces on aircraft tyres. Part 5: Estimation of fluid drag forces
[ESDU-90035] N91-21537
YEAST
Aerobic production of ethanol
[PB91-119172] N91-21324
YIELD STRENGTH
The interlaminar shear strength of woven carbon, woven glass and woven carbon/glass hybrid laminates under static and impact loading N91-21247
Deformation substructures induced by high-rate deformation
[DE91-008595] N91-21288
A comparison of calculational results with experimental data for long rod projectiles
[DE91-009006] N91-21536
YTTERBIUM
Double 4f-collapse in Ce(0.9-x)Yb(x)Th(0.1)
[DE91-619752] N91-21908
YTTRIUM
Stress-strain gage measurements on a Nevada Test Site (NTS) event using pairs of triple foil gages
[DE91-005061] N91-21497
YTTRIUM OXIDES
Structural characterization of the Ag/YBa2Cu3O(7-x) interface
[DE91-009112] N91-21907
Magnetic field induced broadening of the resistive transition in epitaxial films of YBa2Cu3O7 and Y2Ba4Cu8O16
[DE91-009825] N91-21916
Growth and characterization of thin films of Y2O3, La2O3 and La2CuO4
[AD-A231046] N91-21919
YTTRIUM-IRON GARNET
Experimental investigation of scattering of magnetostatic waves by surface acoustic waves
[DE91-009435] N91-21835

Z

ZEOLITES
Zeolites in space N91-21165
ZINC COATINGS
Micromechanisms of friction in electrogalvanized sheet steel with emphasis on the role of texture
[DE91-009113] N91-21290

PERSONAL AUTHOR INDEX

Typical Personal Author Index Listing



Listings in this index are arranged alphabetically by personal author. The accession number denotes the number by which the citation is identified.

A

AARONS, JULES N91-21658
ABDELSALAM, MOUSTAFA K. N91-21197
N91-21201
ABDUL-AZIZ, ALI N91-21558
ABEY, A. E. N91-21815
ABRAHAO, ADRIANA N91-21615
ACHACHE, JOSE J. N91-21598
ADAMCZYK, JOHN J. N91-21069
ADAMIAN, S. N91-21628
ADAMOVSKY, GRIGORY N91-21871
ADAMS, GEORGE F. N91-21442
ADAMS, JOHN B. N91-21594
ADE, PETER N91-22045
ADELMAN, HOWARD M. N91-21577
AGRANAT, AHARON N91-21917
AITKEN-CADE, PHILIP B. N91-21552
ALBERS, JAMES A. N91-22066
ALEXANDER, DENNIS R. N91-21485
ALI, AKHTAR-UZ-ZAMAN M. N91-21440
ALLAIRE, PAUL E. N91-21206
ALLEN, CHRISTOPHER J. N91-21910
ALLEN, JAMES L. N91-21374
ALLEN, JANICE K. N91-21496
ALLEN, W. W. N91-21394
ALLEY, W. E. N91-21503
ALMAHROOS, H. M. H. N91-21093
ALVALA, PLINIO CARLOS N91-21406
ALVES, MARIA VIRGINIA N91-21432
ALVESMOREIRA, MAURICIO N91-21609
ALVIN, KENNETH F. N91-21729
N91-21730
N91-21731
N91-21732
ALVISO, C. T. N91-21312
AMATO, N. N91-22062
AMBROSE, W. P. N91-21521
N91-21926
AMES, TROY N91-21948
AMICONE, L. N91-22040
AMIDON, BRUCE D. N91-21551
AMUEDO, KURT C. N91-21116
ANAND, M. S. N91-21081
ANDERSEN, ARNFINN G. N91-21165
ANDERSEN, B. N. N91-21167
ANDERSON, ALLEN JOEL N91-21597
N91-21599
ANDERSON, J. T. N91-21792
ANDERSON, JAMES A. N91-21782
ANDERSON, T. W. N91-21809
ANDERTON, D. N91-21487
ANDO, NORIYUKI N91-21386
ANDRE, P. N91-22007
ANDREANI, P. N91-21999
ANDREASSEN, O. N91-21163
ANDREWS, J. W. N91-21283
ANDREWS, ROBERT J. N91-21212
ANGEL, S. M. N91-21498
ANIKUMAR, A. V. N91-21375
ANISKOVICH, V. N91-21998
APFEL, R. E. N91-21357
ARATA, N. N91-22062
ARBIT, H. A. N91-21235
ARCONE, STEVEN A. N91-21418
ARDANUY, P. E. N91-21670
ARMSTRONG, ELIZABETH S. N91-21233
ARNONE, ANDREA N91-21071
ASELAGE, T. L. N91-21914
ASHE, HARRY N91-21430
ASKEW, GREGORY K. N91-21719
ASKNE, J. N91-22050
AST, D. G. N91-21305
ATASSI, HAFIZ M. N91-21067
ATKINSON, L. P. N91-21686
ATTAWAY, S. W. N91-21564
AZUMA, HISAO N91-21338

B

BAARS, JACOB W. M. N91-22033
BACHALO, WILLIAM D. N91-21459
BACHE, T. C. N91-21792
BACHMANN, STEVEN E. N91-21259
BACK, L. H. N91-21264
BACKUS, GEORGE E. N91-21598
BADINELLI, MARTIN N91-21833
BADRUZZAMAN, A. N91-21750
BAGLIO, J. N91-21918
BAHR, G. K. N91-21236
BAIR, R. A. N91-21267
BAKER, CLIFFORD N91-21948
BAKER, NATHANIEL R. N91-21098
BAKKEN, PETTER N91-21164
BALACHANDAR, S. N91-21453
BALDWIN, R. T. N91-21653
N91-21654
BALLUFFI, R. W. N91-21905
BALOOCH, M. N91-21274
BANSAL, NAROTTAM P. N91-21910
BAO, HAN P. N91-21733
BARBER, P. G. N91-21373
BARDWELL, C. A. N91-21667
BARMATZ, MARTIN N91-21333
N91-21355
N91-21368
N91-21376
BARRON, ERIC E. N91-21594
BARSKY, MICHAEL F. N91-21186
BASEGGIO, FRANCO M. N91-21168
BASS, J. M. N91-21239
BASS, R. G. N91-21306
N91-21308
BASTIAN, R. D. N91-21325
BASTIAS, P. C. N91-21526
BATTS, G. W. N91-21633
BAUER, R. N91-21547
BAUM, KENNETH D. N91-21736
BAUMGARDT, D. N91-21792
BAYAZITOGLU, YILDIZ N91-21346
N91-21377
BAYKARA, TARIK N91-21344
BEAL, MADELEINE M. N91-21874
BEATTIE, CHRISTOPHER A. N91-21213
BEATTY, JOHN H. N91-21300
BEDAIR, SALAH N91-21927
BEEMAN, J. W. N91-22005
BEER, STEFAN N91-21938
BEHRMANN, P. N91-21337
BEHROOZI, V. N91-21443
BEICHMAN, CHARLES A. N91-22001
N91-22012
BELL, R. L. N91-21740
BELLAN, J. N91-21264
BELVIN, W. KEITH N91-21578
N91-21731
N91-21732
BENCIC, TIMOTHY J. N91-21116
BENEDITODIEHL, JOAO N91-21747
BENNETT, C. L. N91-21988
BENNETT, P. A. N91-21932
BENSEL, CAROLYN K. N91-21721
BENTON, EDWARD R. N91-21598
BERGERON, DENIS N91-21483
BERKE, LASZLO N91-21559
BERKER, D. R. N91-21482
BERRY, ANTHONY N91-21545
BERRYMAN, HARRY N91-21724
BERZ, M. N91-21508
BESMANN, T. M. N91-21304
BETZ, ALBERT L. N91-22016
BEVER, GLENN A. N91-21135
BEZDEK, JAMES C. N91-21783
BHARGAVA, V. N91-21526
BHARTIA, P. K. N91-21670
BHATNAGAR, V. P. N91-21886
BHATT, RAMAKRISHNA T. N91-21243
BICCHI, ANTONIO N91-21500
BIEBER, MICHAEL N91-21951
BIHARI, BARNA L. N91-21065
BILL, ROBERT C. N91-21531
BISACCHICOELHO, ORLANDO N91-21743
BJOERNSTROEM, GUNNAR N91-21164
BLOCKSOM, ROLAND N91-21422
BLOOM, ARTHUR A. N91-21594
BLOSS, WALTER L. N91-21904
BOATMAN, J. F. N91-21667
BOBROVA, T. A. N91-21909
BOCK, YEHUDA N91-21591
BOGGESS, N. W. N91-21988
BOLLAG, J.-M. N91-21703
BONADONNA, MICHAEL F. N91-21660
BONSE, U. N91-21554
BOOM, ROGER W. N91-21197
BOOTH, R. S. N91-22008
N91-22050
BOREIKO, R. T. N91-22016
BOROVSKI, R. N91-21998
BOSCARELI, A. N91-22041
BOSLEY, ROBERT W. N91-21190
BOULANGER, F. N91-22028
BOURELL, D. L. N91-21298
BOWER, A. P. N91-21526
BOWERS, K. L. N91-21796
BOYLE, J. M. N91-21803
BRAET, RONALD L. N91-21735
BRAGA, CLAUDIA ZUCCARI FERNANDES N91-21603
BRANDHORST, HENRY W., JR. N91-21240
BRANNON, P. J. N91-21506
BRANS, HENRY N91-21941
BRASE, J. N91-21488
BRATT, S. R. N91-21792
BRAUN, W. C. N91-21670
BREED, CAROL N91-21594
BRENER, NATHAN E. N91-21329
BRENNAN, T. M. N91-21510
BRENTNER, KENNETH STEVEN N91-21827
BRESCIANINI, C. N91-21139
BREUEL, THOMAS M. N91-21767
BREUNIG, T. M. N91-21554
BRILL, KEITH F. N91-21661
N91-21662
N91-21663
BRINKER, C. J. N91-21872
BRISTOWE, P. D. N91-21905
BRITCHER, COLIN P. N91-21188
N91-21202
N91-21203
BRITOCRUZ, MARIA LUCIA N91-21620
BROIDO, DAVID A. N91-21929
BRONSARD, LIA N91-21480
BROUSSEAU, NICOLE N91-21413
BROWN, D. L. N91-21462
BROWN, DAVID R. N91-21270
BROWN, GERALD V. N91-21194
BROWN, I. G. N91-21291
BROWN, KENNETH G. N91-21270
BROWN, LORETTA M. N91-21971
N91-21972
BROWNE, J. C. N91-21816
N91-21818
BRUNER, ANNE M. N91-21578
BRYAN, KURT N91-21800
BUCHANAN, M. V. N91-21265
N91-21278
BUCHOLZ, ROGER N91-21422
BUCZKOWSKI, A. N91-21912

BUDA, F. N91-21315
BUDHANI, R. C. N91-21916
BUDILOVICH, N. N91-21998
BUISSON, F. N91-22038
BULLARD, RANDY N91-21137
BULLOCK, ELLEN PARKER N91-21127
BUNGAY, H. R. N91-21324
BURBIDGE, GEOFFREY N91-21992
BURES, M. N91-21886
BURNSIDE, W. D. N91-21394
BURRELL, K. H. N91-21887
N91-21888
BURRIS, JOHN E. N91-21697
BUSHNELL, MARK N91-21685
BUTLER, CHALMERS M. N91-21438
BUTLER, DAVID H. N91-21183
BUTLER, KAREN A. N91-21450
BUTTRILL, CAREY S. N91-21144

C

CAI, WEI N91-21456
CAIAFA, CAESAR A. N91-21238
CALISSE, P. N91-22036
N91-22040
CALLAWAY, JOSEPH N91-21329
CALOMINO, ANTHONY M. N91-21540
CAMPBELL, D. J. N91-21882
CANAVAN, G. H. N91-21226
N91-21812
N91-21813
N91-21814
N91-21816
N91-21817
N91-21818
N91-21819
CANNIZZARO, FRANK E. N91-21795
CANNON, ROBERT H., JR. N91-21527
CAR, R. N91-21315
CARDONI, G. N91-22041
CARDONI, M. N91-22042
CARLSTROM, T. N. N91-21887
N91-21888
CARPENTER, DAVID N91-21717
CARPENTER, M. H. N91-21095
CARPER, DOUGLAS M. N91-21557
CARRARA, VALDEMIR N91-21170
N91-21218
CASS, R. D. N91-21395
CASS, TODD A. N91-21766
CASTANEDA, PEDRO P. N91-21260
CATTIN, E. N91-21104
N91-21106
CAULEY, MICHAEL A. N91-21184
CAUOCS, MICHAEL R. N91-21695
CECIL, F. E. N91-21889
CEZAIRLIYAN, A. N91-21347
N91-21361
CHABALOWSKI, CARY F. N91-21442
N91-21854
CHAKRAVARTHY, SUKUMAR R. N91-21065
CHAMIS, C. C. N91-21562
CHAN, J. C.-L. N91-21679
CHANDLER, W. S. N91-21686
CHANG, G. C. N91-21076
CHANG, R. F. N91-21361
CHANG, SHIH-HUNG N91-21074
CHARALAMBIDIS, D. N91-21514
CHASE, CLEMENT G. N91-21592
CHATTOPADHYAY, S. N91-21508
CHEN, CHARLES C. T. N91-21238
CHEN, S. S. N91-21582
CHEN, SHERRY CHOU N91-21614
CHENG, E. S. N91-21988
CHEW, MENG-SANG N91-21576
CHIANG, LIU CHAN N91-21608
CHIAROTTI, GUIDO L. N91-21315
CHIN, R. C. Y. N91-21462
CHINI, R. N91-22007
CHO, J. H. N91-21295
CHONG, K. P. N91-21732
CHOO, YUNG K. N91-21090
CHOU, SHAU-TAK RUDY N91-21829
CHOW, W. N91-21512
CHOY, FRED K. N91-21534
CHRISTENSEN, J. J. N91-21511
CHRISTENSEN, P. L. N91-21279
CHRISTIAN, STACEY W. N91-21768
CHRISTMAN, LINDA A. N91-21943
CHUI, CHARLES K. N91-21839
CHULYA, ABHISAK N91-21243
CHUNG, CARL A. N91-21518
CHURCH, SARAH N91-22045
CLARK, E. L. N91-21802
CLARK, STEWART D. W. N91-21162
CLARK, TERRY L. N91-21631
CLAUSER, JOHN F. N91-21857
CLEMENT, WARREN F. N91-21149
N91-21150
CLESCERI, L. S. N91-21324
COATS, D. E. N91-21481
N91-21482
COFFEY, HELEN E. N91-22059
COHEN, ARTHUR N91-21328
COHEN, J. B. N91-21589
COHEN, LESLIE N91-21931
COLE, JAMES B. N91-21869
COLE, STANLEY R. N91-21177
COLLINS, C. B. N91-21520
COLLINS, DEAN R. N91-21782
COLLINS, J. N91-21851
COLSTON, B. W., JR. N91-21498
CONCEICAO, J. N91-21261
CONDON, GREGORY W. N91-21131
COOKE, J. D. N91-21511
CORVO, A. N91-21507
COTTRELL, G. A. N91-21886
COURTRIGHT, E. L. N91-21311
COVENTRY, DALE H. N91-21631
COVINO, A. F., JR. N91-21834
COYNER, KARL B. N91-21650
CRANE, J. K. N91-21509
N91-21511
CREAGER, N. A. N91-21505
CRIMINALE, W. O. N91-21474
CROONQUIST, A. P. N91-21356
CROSIAR, C. N91-21676
N91-21681
CROSLEY, D. R. N91-21262
CROSS, J. B. N91-21286
CROSS, L. E. N91-21877
CROUCH-BAKER, S. N91-21360
CROUSE, KEN N91-21950
CROVISIER, JACQUES N91-22037
CRUM, LAWRENCE A. N91-21840
CRUZ, JONATHAN N. N91-21214
CUCINOTTA, FRANCIS A. N91-21860
CULLEN, C. N91-21239
CUNNINGHAM, COLIN R. N91-22044
CURTIS, E. N91-21354
CURTIS, R. S. N91-21711
CUSHMAN, ARTHUR N91-21833
CUSHMAN, R. M. N91-21637

D

DACOSTA, JOSE MARQUES N91-21651
DAEHNICK, CHRISTIAN C. N91-21256
DALEY, P. F. N91-21498
DALGARNO, A. N91-22025
DALLAQUA, RENATO SERGIO N91-21895
DALLOGLIO, G. N91-22036
DAMICO, KEVIN L. N91-21374
DAMINI, A. N91-21443
DANESE, L. N91-21995
DANIELS, TAUMI S. N91-21199
DANLEY, T. J. N91-21372
DARKO, ROBERT J. N91-21942
DAVENPORT, A. J. N91-21293
N91-21295
DAVID, S. A. N91-21289
DAVIDSON, JACQUELINE A. N91-22003
DAVIES, J. K. N91-22048
DAVILAMASCARENHAS, NELSON DELFINO N91-21612
DAVIS, BRUCE E. N91-21974
DAVIS, PATRICIA P. N91-21270
DAVIS, ROBERT F. N91-21317
N91-21927
DAWSON, L. R. N91-21510
DEALMEIDAPRADO, ANTONIO FERNANDO BERTACHIN N91-21171
DEARDORFF, M. B. N91-21985
DEATON, JOHN E. N91-21709
DEBERNARDIS, PAOLO N91-21991
N91-22040
N91-22041
N91-22042
DEBNAM, W. J. N91-21373
DECKER, M. N91-21647
DEDE, CHRISTOPHER J. N91-21776
N91-21952
DEFARIA, KLEBER N91-21636
DEGRAAUW, THIJS N91-22026
N91-22046
DEGUIRE, MARK R. N91-21553
N91-21910
DEJNEKA, KATHERINE Y. N91-21719
DEJONG, TEIJE N91-22006
DELBOSCO, EDSON N91-21895
DELLACORTE, CHRISTOPHER N91-21302
DELOURDESNEVESDEOLIVEIRAKURKDJIAN, MARIA N91-21616
DELUCA, A. N91-22040
DEMATTOS, JUERCIO TAVARES N91-21606
N91-21618
DEMETRIADES, ANTHONY N91-21501
DEMMEL, JOHANN N91-21123
DEMOURAABDON, MYRIAN N91-21607
DEMPSEY, BERT J. N91-21403
DENHAM, MARK C. N91-21752
DENINNO, A. N91-22041
N91-22042
DENTREMONT, ROBERT P. N91-21624
DEOLIVEIRA, CARLOS ALBERTO N91-21742
DEOLIVEIRA, JOSE LUIS N91-21126
DEPETRIS, M. N91-22040
N91-22041
N91-22042
DERIAN, L. N91-21628
DEROCHEMONT, L. PIERRE N91-21212
DEROUCHEY, WILLIAM J. N91-21754
DESILVA, SHANAKA N91-21641
DESJARDINS, MARY L. N91-21661
N91-21662
N91-21663
DESMOND, GREGORY B. N91-21623
DETAVERNIER, S. N91-21325
DETRY, R. J. N91-21964
DEVENPORT, WILLIAM J. N91-21100
DEWAN, E. M. N91-21659
DEZOTTI, G. N91-21995
DHEANDHANOO, S. N91-21855
DHENDECOURT, L. B. N91-22022
DIBARI, M. T. N91-22036
DICARLO, JAMES A. N91-21309
DICKEY, JEAN O. N91-21596
DICKINSON, M. R. N91-21291
DICKMAN, STEVEN R. N91-21596
DIEHL, B. C. N91-21679
DIERLAM, TODD A. N91-21228
DIETRICH, DANIEL L. N91-21182
DIETZ, K. L. N91-21142
DILL, JAMES F. N91-21211
DILLEY, A. D. N91-21089
DISIMILE, P. J. N91-21236
DIXON, GENE A. N91-21710
DODD, F. E. N91-21235
DOGGETT, WILLIAM R. N91-21183
DOHRENWEND, J. N91-21594
DOHRMANN, C. R. N91-21565
DOLHERT, LEONARD E. N91-21553
DOMINGUEZ, R. R. N91-21887
DOMOKOS, G. N91-21484
DONALD, BRUCE R. N91-21550
DONGARRA, JACK J. N91-21805
DONOHUE-PERRY, MARY M. N91-21716
N91-21718
DOSS, S. N91-21903
DOUCET, GLENN N91-21133
DOWNER, JAMES N91-21191
DOYLE, E. J. N91-21888
DRYZEK, J. N91-21890
DU, J. N91-21526
DUAN, H. M. N91-21212
DUBOIS, P. F. N91-21516
DUCHARME, S. N91-21322
DUKES, MICHAEL A. N91-21761
DULIKRAVICH, GEORGE S. N91-21077
DUNIGAN, T. H. N91-21774
DUNLAP, SUSAN L. N91-21723
DUNN, B. N91-21360
DUNN, S. S. N91-21482
DUPEROUX, J.-P. N91-21106
DUPUIS, A. D. N91-21105
DURAN, M. N91-22038
DUTTON, ROBERT W. N91-21757
DWIGHT, K. N91-21918
N91-21919
N91-21920
DYRDAL, IDAR N91-21145
N91-21146
N91-21147
N91-21148
DZIEWONSKI, ADAM M. N91-21595

E

EASTERDAY, J. D. N91-21251
EATON, D. S. N91-21965
EBERHARD, WYNN N91-21648
N91-21665
EDDINGTON, L. W. N91-21690
EDELSACK, EDGAR A. N91-21931
EDIGHOFFER, J. N91-21508
EDWARDS, DANIEL L. N91-21623

EDWARDS, PHILLIP M. N91-21302
EGAMI, TAKESHI N91-21924
EGRY, I. N91-21348
N91-21350
EICHERT, HELMUT N91-21268
EILTS, MICHAEL D. N91-21671
EISEMAN, PETER R. N91-21090
EISENBERG, R. N91-21277
EISENREICH, S. J. N91-21629
EISMANN, M. N91-21502
EKLUND, TOM N91-21546
ELIEZER, Z. N91-21298
ELLEMAN, D. D. N91-21370
ELMILIGUI, ALAA N91-21795
ELSBERRY, RUSSELL L. N91-21679
EMIN, D. N91-21914
EMRICH, ANDERS N91-22043
EMRICH, ANDEWS N91-22050
ENCRENAZ, PIERRE N91-22020
ENCRENAZ, THERESE N91-22037
ENDE, H. N91-21151
ENDECOTT, BOYD R. N91-21708
ENGELMANN, B. E. N91-21584
EPIFANI, M. N91-22040
N91-22041
EPIPHANIO, JOSE CARLOS NEVES N91-21604
EPLEE, R. E., JR. N91-21988
EPPARD, W. M. N91-21089
ERICKSON, N. R. N91-22025
ERICKSON, S. A. N91-21815
ERIKSSON, L. G. N91-21886
ERLEBACHER, GORDON N91-21099
ERMAK, D. L. N91-21638
ERWERT, RONALD E. N91-21429
ETHRIDGE, EDWIN C. N91-21351
EUBANKS, MARSHALL T. N91-21596
EUSTAQUIODOSANJOS, CELIO N91-21610
EVANS, DIANE L. N91-21594
EVANS, ROGER J. N91-21524
EVELAND, J. D. N91-21959
EVERY, A. G. N91-21928
EYSSA, Y. M. N91-21197
N91-21201

F

FABBRI, A. G. N91-21617
FAENGMARK, INGRID ELISABET N91-21269
FALES, JANINE L. N91-21585
FALGARONE, EDITH N91-22011
FANTASIA, PETER M. N91-21543
FARKAS, GY. N91-21514
FARR, THOMAS T. N91-21594
FARRELL, DAVID E. N91-21910
FARRELL, P. N91-21354
FARRELL, W. E. N91-21792
FARWELL, ROBERT W. N91-21836
FASANELLA, EDWIN L. N91-21556
FAYMON, KARL A. N91-21240
FAYMONVILLE, RUDOLF N91-22045
FAZIO, G. G. N91-22025
FECHT, HANS J. N91-21343
FEISSEL, MARTINE N91-21596
FELDBERG, S. W. N91-21271
FELSCH, P. N91-21668
FENG, CHEN N91-21351
FENG, S. T. N91-21870
FERREIRA, JOSE LEONARDO N91-21896
FERREIRA, LUIZ DANILO D. N91-21218
FERRIS, K. F. N91-21310
N91-21313
FEUER, HENRY O., JR. N91-21327
FILHO, PEDRO HERNANDEZ N91-21636
FINAN, VALERIE N91-21910
FISCHER, J. N91-21513
N91-21515
FISCHER, KENNETH J. N91-21588
FITCH, J. P. N91-21407
FITE, W. N91-21855
FLEISCHAUER, P. D. N91-21547
FLOOD, DENNIS J. N91-21433
FLOOD, JOSEPH D. N91-21116
FLOWER, JON W. N91-21771
N91-21772
FLYNN, FREDERICK J. N91-21193
FOLEY, G. M. N91-21361
FOLEY, HENRY C. N91-21353
FOLEY, ROBERT J. N91-21059
FORDYCE, J. STUART N91-21240
FORESTI, CELINA N91-21216
FORMAGGIO, ANTONIO ROBERTO N91-21602
N91-21604
N91-21619
FORMENTO, J. W. N91-21748
FORNEY, L. J. N91-21489
FORVEILLE, THIERRY N91-22007
FOTAKIS, C. N91-21514
FOWLER, T. K. N91-21898
FOX, DANTEL N. N91-21695
FOX, ERIC E. N91-21118
FOX, R. J. N91-21364
FRALICK, G. C. N91-21489
FRANCESCHINI, ALBERTO N91-21995
N91-21999
FRANCIS, PETER W. N91-21593
FRANZ, T. P. N91-21629
FREDERICKSON, PAUL O. N91-21764
FREED, A. D. N91-21797
FREEDMAN, GLENN B. N91-21945
FRENCH, DONALD A. N91-21806
FRERKING, MARGARET A. N91-22017
FREUDENREICH, H. T. N91-21988
FREY, JEFFREY N91-21439
FRIEDMAN, H. W. N91-21511
FRIEDMAN, ROBERT N91-21182
FRIESEL, M. A. N91-21251
FRIPP, ARCHIE L. N91-21373
FRISK, URBAN N91-21990
N91-22050
FROEBEL, RICHARD C. N91-21493
FUCHS, KARL W. N91-21599
FUHRY, DOUGLAS P. N91-21168
FULTON, JOHN N91-21476

G

GAETA, ALEXANDER L. N91-21522
GAL-CHEN, TZVI N91-21665
GALLANT, A. RONALD N91-21780
GALTELAND, J. N91-21163
GALVAO, FRANCISCO LEME N91-21217
GALVIN, J. E. N91-21291
GAMBLE, M. T. N91-21862
GAMLIEL, AVSHALOM N91-21411
GAMWELL, W. R. N91-21287
GANDELMAN, GILBERTO N91-21746
GANEKA, YASUHIRO N91-21599
GAO, Y. M. N91-21919
GARBER, F. D. N91-21417
GARECHT, DIANE N91-21231
GARG, SANJAY N91-21137
N91-21140
GARMIRE, ELSA N91-21922
GARRARD, WILLIAM L. N91-21153
GATELY, MICHAEL T. N91-21782
GAUGHAN, DANIEL J. N91-21428
GAUR, VINOD N91-21599
GAUTIER, B. N91-21106
GAVER, DONALD P. N91-21811
GEAR, WALTER K. N91-22000
N91-22044
GEHRET, J. N91-21389
GEIS, N. N91-21996
N91-22005
GELFAND, A. E. N91-21810
GENZEL, REINHARD N91-21996
N91-22002
N91-22005
GEORGE, RAY N91-21154
GEORGE, THOMAS F. N91-21925
GERASIMOV, A. N91-21864
GERNANDT, L. N91-21173
GERSTMAN, DAVID H. N91-21869
GERVASI, M. N91-22040
N91-22041
N91-22042
GHARABEGIAN, A. N91-21628
GILES, MICHAEL B. N91-21064
GILLESPIE, ALLAN R. N91-21594
GILMORE, FORREST R. N91-21263
GILYARD, GLENN B. N91-21446
GIRAUD, M. N91-21105
GLEASON, KAREN K. N91-21323
GLEGG, STEWART A. L. N91-21100
GLICKSMAN, M. E. N91-21359
GLUSHKO, ROBERT J. N91-21946
GLYMOUR, CLARK N91-21794
GNEMMI, F. N91-21832
GNEMMI, P. N91-21831
GODECHOT, X. N91-21291
GODOYJUNIOR, MOACIR N91-21615
GOHIL, P. N91-21887
N91-21888
GOLD, RONALD R. N91-21176
GOLDEN, D. M. N91-21262
GOLDEN, J. N91-21868
GOLDEY, C. L. N91-21198
GOLDIE, JAMES N91-21191
GOLDSMITH, P. F. N91-22025
GOLEC-BIERNAT, K. N91-21798
GONDHALEKAR, VIJAY N91-21195
GORDER, PETER J. N91-21149
N91-21150
GOROCH, ANDREAS K. N91-21680
GORRELL, STEVEN E. N91-21143
GOTTLIEB, DAVID N91-21801
GOUGH, R. N91-21508
GOURLEY, P. L. N91-21510
GOVINDAN, T. R. N91-21821
GRAY, G. T., III N91-21288
GRAY, J. N91-21488
GREEN, ANDREW A. N91-21599
GREEN, G. R. N91-21128
GREENHILL, L. M. N91-21530
GREENLAND, D. N91-21632
GREGG, W. W. N91-21670
GREGORY, D. L. N91-21583
GRIEM, H. R. N91-21900
GRIFFIN, MATT N91-22045
GRIFFIN, MICHAEL K. N91-21624
GRINAKER, STEIN N91-21145
N91-21146
N91-21147
N91-21148
GRODSINSKY, CARLOS M. N91-21194
N91-21206
GROEBNER, R. J. N91-21887
N91-21888
GROOM, NELSON J. N91-21188
N91-21200
N91-21202
N91-21203
N91-21539
N91-21824
GROPP, WILLIAM D. N91-21457
GROSS, D. N91-21369
GROSSBERG, STEPHEN N91-21777
GRUBIN, H. L. N91-21821
GRUENEWALD, MARIA M. N91-21963
GRUNWALD, A. J. N91-21134
GUARINI, G. N91-22040
N91-22041
GUERIN, M. R. N91-21278
GUILFOYLE, PETER N91-21736
GULKIS, S. N91-21988
GUPTA, KAJAL K. N91-21587
GUPTA, V. N91-21526
GURDAL, ZAFER N91-21561
GURLEY, L. R. N91-21275
GUTT, G. M. N91-21371
GUVENILIR, A. N91-21554
GUYENNE, T. D. N91-21975
GYEKENYESI, JOHN P. N91-21243

H

HADLEY, G. R. N91-21510
HAERTIG, J. N91-21831
N91-21832
HAFTKA, RAPHAEL T. N91-21577
N91-21580
HAGGERTY, M. N91-22005
HAHN, G. T. N91-21526
HAHS, C. A. N91-21363
N91-21365
HAI, T. N91-21925
HAJELA, PRABHAT N91-21559
HALL, MARY J. N91-21722
HALL, P. N91-21532
HALLER, E. E. N91-22005
HAMMONS, B. E. N91-21510
HAMNER, RICHARD M. N91-21496
HAMPTON, RICHARD D. N91-21192
N91-21206
HANDA, T. N91-22051
HANKS, BRANTLEY R. N91-21572
HANNA, S. M. N91-21835
HANNESFAHR, JENS N91-21823
HANNIGAN, C. N91-21920
HANSEN, R. N91-21586
HANSEN, S. N91-21549
HARDING, J. N91-21244
N91-21245
N91-21246
N91-21247
N91-21248
N91-21249
N91-21250
HARDWICK, CHARLES N91-21950
HARMER, T. J. N91-21803
HARR, P. A. N91-21679
HARRIS, ANDREW I. N91-22010
HARRIS, J. W. N91-21844
HARRIS, S. E. N91-21523
HARRISON, CHRISTOPHER G. A. N91-21598

HARSTAD, K. N91-21264
HARTFIELD, J. N91-21354
HARTMANN, CARLOS R. N91-21440
HARVEY, JAMES D. N91-21741
HARVEY, TINA M. N91-21962
HARWIT, MARTIN N91-21987
N91-22025
HASEGAWA, T. N91-22051
HASHIDATE, MASATAKA N91-21112
HASHIM, SAFAA H. N91-21957
HASSELMAN, D. P. N91-21928
HASTINGS, DANIEL N91-21881
HAUGE, ROBERT H. N91-21344
HAUGEN, G. N91-21676
N91-21681
HAUPT, ROBERT W. N91-21650
HAUSER, M. G. N91-21988
HAVENHILL, DOUGLAS G. N91-21189
HAWARDEN, T. G. N91-22048
HAWKEY, TIMOTHY N91-21195
HAWKINS, J. N91-21294
HAWKINS, RICHARD W. N91-21098
HAYASHI, ISAO N91-21785
HAYASHI, M. N91-22051
HAYS, A. K. N91-21391
HECK, MICHAEL L. N91-21581
HEDGES, JEFFREY R. N91-21683
HEDMAN, SVEN G. N91-21110
HEDRICK, J. KARL N91-21193
HEDSTROM, G. W. N91-21462
HEEGER, A. J. N91-21320
HELFAND, DAVID J. N91-21728
HELLER, ADAM N91-21856
HELLSTEN, T. N91-21886
HELOU, GEORGE N91-22001
N91-22049
HENAGER, C. H., JR. N91-21251
HENDERSON, T. L. N91-21091
HENDERSON, THOMAS N91-21125
HENDRICKS, R. W. N91-21289
HENNING, THOMAS L. N91-21177
HEPP, ALONYSIUS F. N91-21553
HERGENROTHER, P. M. N91-21306
N91-21308
HERING, WAYNE S. N91-21678
HERMAN, R. G. N91-21325
HERMANN, A. M. N91-21212
HERMES, LAURIE G. N91-21671
HERRING, THOMAS A. N91-21596
HERTEL, E. S., JR. N91-21536
HESKE, ASTRID N91-22022
HESS, CLIFFORD W. N91-21542
HETTCHEN, WILLIAM N91-21424
HETTICH, R. L. N91-21265
HEWETT, D. W. N91-21902
N91-21903
HEWITT, JYUJI D. N91-21284
HEYERDAHL, EILERT N91-21145
N91-21146
N91-21147
N91-21148
HICKEN, STEVE N91-21230
HILDEBRAND, ROGER H. N91-22003
HILL, DAVID C. N91-21220
HILL, RANDALL W., JR. N91-21949
HILL, RAYMOND R., JR. N91-21555
HILLGER, D. W. N91-21666
HILLS, BETHANIE J. N91-21910
HILLS, RICHARD N91-22031
HILTON, M. R. N91-21547
HINGORANI, S. L. N91-21280
HINGST, W. R. N91-21085
N91-21115
HINKLE, G. ROSS N91-21635
HIRAOKA, KOICHI N91-21382
HIROMOTO, N. N91-22004
HIROSE, HIDEHIRO N91-21383
HIROSE, NAOKI N91-21114
N91-21385
HIROTA, KAORU N91-21786
HITCHCOCK, EDWARD N91-21709
HJALMARSSON, A. N91-22050
HMELO, ANTHONY B. N91-21374
HOANG, NAM V. N91-21943
HOBSON, GARTH VICTOR N91-21078
HOCKNEY, RICHARD N91-21195
HODGE, A. J. N91-21242
HODGKISS, WILLIAM S. N91-21414
N91-21415
N91-21692
HOFFBAUER, M. A. N91-21286
HOFFERT, M. I. N91-21639
HOFFMANN, HANS-EBERHARD N91-21123
HOFFMEYER, JAMES A. N91-21396
N91-21397
HOFLAND, ROBERT N91-21878
HOFMEISTER, WILLIAM H. N91-21334
N91-21335
HOLLAND, G. J. N91-21679
HOLLAR, D. L., JR. N91-21535
HOLLENBACH, D. J. N91-22025
HOLM, SVERRE N91-21161
HOLMES, HUGHES E. N91-21328
HOLMES, MICHAEL N91-21709
HOLMET, ANN-LISBETH RUUD N91-21159
HOLT, R. G. N91-21357
HOMER, G. DAVID N91-21307
HONMA, MASAYUKI N91-21491
HONTZOPOULOS, E. N91-21514
HORN, W. J. N91-21563
HORNE, W. CLIFTON N91-21828
HORNIK, KURT N91-21780
HORTA, LUCAS G. N91-21578
HORTON, W. N91-21894
HORWEDEL, J. E. N91-21751
HOSHINO, HIDEO N91-21113
HOU, THOMAS Y. N91-21479
HOUCK, JACOB A. N91-21144
HOWARD, R. P. N91-21142
HOWE, JOHN T. N91-21471
HOYLE, FRED N91-21992
HRYNKIEWICZ, A. Z. N91-21890
HSIAO, M.-Y. N91-21901
HSU, HSIAO-HUA N91-21841
HUANG, C. Y. N91-21239
HUFFINES, GARY R. N91-21423
HUGHES, DAVID N91-22000
HUMPHREY, JOSEPH W. N91-21079
HUNT, B. D. N91-22017
HUNTLEY, BONITA A. N91-21328
HURBAN, THERESA N91-21183
HURD, A. J. N91-21872
HYER, MICHAEL W. N91-21557
N91-21560
HYLAND, S. L. N91-21305

I

IACOANGELI, A. N91-22036
ICHIKAWA, YOSHI H. N91-21894
IDA, K. N91-21891
IGUCHI, H. N91-21891
IKOMA, NORIKAZU N91-21786
ILGNER, R. H. N91-21278
INABA, T. N91-21866
INOUE, KENJI N91-21111
IRENE, EUGENE A. N91-21283
N91-21870
N91-21923
ISAACMAN, R. B. N91-21988
ISAACS, H. S. N91-21293
N91-21294
N91-21295
N91-21296
ISAKS, B. L. N91-21594
ISHIDA, YOJI N91-21113
ISOGAI, KOJI N91-21385
ITOH, K. N91-21891
N91-21893
ITOH, S.-I. N91-21893
IYER, V. S. N91-21289

J

JACKSON, J. M. N91-21996
N91-22005
JACKSON, KAREN E. N91-21556
JACOBS, P. A. N91-21139
JACOBS, PATRICIA A. N91-21811
JACOBSSON, S. N91-22050
JACQUINOT, J. N91-21886
JAGUSINSKI, F. N91-21104
JAIN, RAJ K. N91-21433
JAMES, GORDON E. N91-21541
JANSSEN, M. N91-21988
JANSWEIJER, P. P. M. N91-21863
JARLAAS, ROLF N91-21568
JARRE, FLORIAN N91-21765
JASPER, G. L. N91-21633
JASPER, WARREN JOSEPH N91-21528
JATEGAONKAR, RAVINDRA N91-21130
JAYARAM, GEETHA N91-21776
JENSEN, B. J. N91-21306
N91-21308
JENSEN, JAMES O. N91-21442
N91-21854
JETT, T. N91-21532
JEWELL, WAYNE F. N91-21149
N91-21150
JEWITT, DAVID N91-22052
JIASEN, HU N91-21469
JIMENEZRUEDA, JAIRO ROBERTO N91-21618
JIN, C. N91-21261
JIN, YANHE N91-21843
JOHNS, ALBERT L. N91-21116
JOHNS, ELIZABETH N91-21685
JOHNSON, BRUCE G. N91-21193
JOHNSON, BURGESS N91-21930
JOHNSON, D. R. N91-21691
JOHNSON, E. W. N91-21861
JOHNSON, ERIC R. N91-21557
JOHNSON, M. A. N91-21511
JOHNSON, R. BARRY N91-21351
JONES, LISA E. N91-21556
JONES, R. H. N91-21251
JONES, W. P. N91-21096
JORDAN, J. N91-21647
JORDAN, K. G. N91-21297
JOSHI, PRAKASH B. N91-21198
JOURDAINDEMUIZON, M. N91-22022
JOYNER, WHITMEL M. N91-21630
JUANG, JER-NAN N91-21573
N91-21574
N91-21575
N91-21578

K

KAIFU, NORIO N91-22051
KALDEICH, B. N91-21986
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KAMATH, PRADEEP S. N91-21098
KAMIONKOWSKI, M. N91-22055
KAMIYA, NOBUHIKO N91-21114
KANE, R. P. N91-21652
KANE, RAJAREM P. N91-22060
KANEKO, H. N91-21892
KANELLAKOPOULOS, I. N91-21793
KANSA, E. J. N91-21497
KAPETANAKOS, C. A. N91-21868
KAPUSCIK, E. N91-21935
KASHANGAKI, THOMAS A. L. N91-21579
KASSOY, D. R. N91-21452
KASTENS, KIM A. N91-21591
KATZBERG, STEVEN J. N91-21183
KAUFMAN, JONATHAN W. N91-21719
KAULA, WILLIAM M. N91-21597
KAYABA, SHIGEO N91-21113
KEARNEY, J. K. N91-21549
KEENE, W. C. N91-21667
KEESEE, J. N91-21209
N91-21210
KEHTARNAVAZ, H. N91-21481
KELLER, DONALD F. N91-21127
KELLER, JAMES M. N91-21787
KELLIHER, WARREN C. N91-21212
KELLMAN, MICHAEL E. N91-21859
KELLY, G. N91-21139
KELLY, M. M. N91-21985
KEMP, WILLIAM B., JR. N91-21155
KENDIG, M. W. N91-21293
KENNEDY, R. M. N91-21688
KESTNER, NEIL R. N91-21329
KETELSEN, DEAN A. N91-21185
KEYES, DAVID E. N91-21457
KHATTAR, MUKESH K. N91-21473
KHOSLA, P. K. N91-21068
N91-21093
KIM, C. N91-21508
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KIM, YONG W. N91-21342
KINGON, A. I. N91-21317
KINNEY, J. H. N91-21554
KIRK, R. GORDON N91-21209
N91-21210
KIRKENDAHL, T. D. N91-21286
KIRLIK, ALEX N91-21939
KITCHEN, TERRY L. N91-21753
KITSOPOULOS, T. N. N91-21853
KIZIAH, REX R. N91-21486
KLEINFELDER, S. A. N91-21436
KLEVGARD, P. A. N91-21825
KLIER, K. N91-21325
KLINGLE-WILSON, DIANA L. N91-21671
KNAPP, BEVERLY G. N91-21722
KNIGHT, JOSIAH N91-21207
KNOSPE, CARL R. N91-21192
N91-21206
KOBAYASHI, Y. N91-22004
KOCH, D. G. N91-22025
KOCH, R. N91-21886
KOCH, S. W. N91-21512

KOENEKE, A. N91-21106
KOKOTOVIC, P. V. N91-21793
KOLAWA, ADAM N91-21771
N91-21772
KOLLBERG, ERIK N91-22050
KONINGSTEIN, ROSS N91-21529
KOONTZ, S. L. N91-21286
KOPLOW, M. N91-21389
KOROGOD, V. N91-21998
KORPINEN, LEENA N91-21705
KOSHIOKA, YASUHIRO N91-21383
KOSKO, BART N91-21779
KOSOV, A. N91-21998
KOST, ALAN N91-21922
KOTANYI, C. N91-22054
KOVESI-DOMOKOS, S. N91-21484
KOZMINCHUK, BRIAN W. N91-21763
KRANTZ, RICHARD J. N91-21904
KRAUSE, KEVIN N91-21420
KREITNER, R. A. N91-21675
KRETSCH, JEFFREY L. N91-21963
KREYSA, ERNST N91-22007
N91-22027
KRISHNAN, SHANKAR N91-21345
N91-21366
N91-21367
KROEMER, HERBERT N91-21921
KRUTZ, ROBERT W., JR. N91-21710
KUBE, ROLAND N91-21152
KUGA, HELIO KOITI N91-21169
N91-21170
KULKARNI, S. M. N91-21526
KUMAR, A. M. N91-21526
KUMAR, AJAY N91-21087
N91-21088
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KUNG, A. H. N91-21508
KUNZ, R. F. N91-21072
KURGAN, C. N91-21287
KUSHIGBOR, C. A. N91-21617
KUSHNER, LAWRENCE J. N91-21437
KUZMIN, YU. V. N91-21936
N91-21937
KVALE, T. J. N91-21849
KWACK, E. N91-21264
KYTOE, MATTI N91-21546

L

LACKMAN, BOB N91-21154
LACKNEY, J. J. N91-21562
LAFF, MARK R. N91-21953
LAHER, RUSS R. N91-21263
LAI, H. T. N91-21092
LAKSHMINARAYANA, B. N91-21072
N91-21078
LAMBERT, ANTHONY N91-21599
LAMBERT, HEATHER H. N91-21446
LAMMERING, ROLF N91-21566
LANG, HAROLD N91-21592
LANG, P. M. N91-21626
LANGEL, ROBERT A. N91-21598
N91-21653
N91-21654
LANGRY, K. N91-21498
LARSON, D. J. N91-21903
LAWING, PIERCE L. N91-21198
LAWRENCE, DEBBIE J. N91-21424
LAZAREWICS, ANDREW R. N91-21597
LEA, ROBERT N. N91-21778
LEACH, M. N91-21125
LEAODEMORAESNOVO, EVLYN MARCIA N91-21603
LEAVITT, DENNIS D. N91-22061
LEDUC, H. G. N91-22017
LEE, ANN K. N91-21412
LEE, CHONG H. N91-21876
LEE, CHUNG M. N91-21272
LEE, DAVID CHUNG LIANG N91-21611
LEE, HWA-PING N91-21223
N91-21224
LEE, J. W. N91-21749
LEE, K. D. N91-21091
LEE, MARK C. N91-21332
LEE, P. N91-21344
LEE, SEUNGSOO N91-21077
LEE, T. M. N91-21810
LEE, TERENCE J. N91-22048
LEFEBVRE, MICHEL N91-21597
LEHMAN, DAVID H. N91-22049
LEHMANN, GERT N91-21152
LEICH, MARTIN N91-21405
LEMAY, J. D. N91-21312
LEMEGALVAO, FRANCISCO N91-21219
LENG, X. N91-21526
LENGSFIELD, BYRON H., III N91-21854
LENSKI, H. N91-21349
LENTINI, D. N91-21096
LEONARD, B. P. N91-21075
LERMA, GUILLERMO N91-21494
LESNIAK, L. N91-21845
LEVI, M. N91-21436
LEW, J.-S. N91-21574
LEWIS, DAVID W. N91-21206
LEWIS, PAUL N91-21211
LEYVA, VICTOR N91-21917
LHEUREUX, JACQUES N91-22063
LI, J. C. N91-21732
LI, LARRY C. H. N91-21542
LI, M. F. N91-21906
LI, Y. L. N91-21244
N91-21245
N91-21246
N91-21247
N91-21248
N91-21249
LI, Z. Y. N91-21925
LICHTIN, NORMAN N. N91-21282
LIERKE, E. G. N91-21356
N91-21369
LIFSHITZ, S. N91-21134
LILLARD, R. S. N91-21296
LIN, D. L. N91-21925
LIN, S.-J. N91-21070
LIN, TRUE-LON N91-21434
LINDAU, I. N91-21867
LINDBERG, M. N91-21512
LINDQUIST, DANA R. N91-21064
LING, LISA M. N91-21168
LIOU, M.-S. N91-21082
LIOU, MENG-SING N91-21071
LIOU, W. W. N91-21086
LITTLE, JILL N91-21927
LITTLE, WILLIAM A. N91-21393
LIU, S. C. N91-21732
LIU, X. N91-21283
LOEB, H. N91-21369
LOHOEFER, G. N91-21350
LOHR, J. M. N91-21887
LONDON, J. E. N91-21275
LONDON, R. N91-21488
LONG, B. N91-21474
LONGAIR, M. S. N91-22048
LONGMAN, RICHARD W. N91-21573
N91-21574
N91-21575
LOOPER, LARRY T. N91-21711
LOPEZ-GOMEZ, R. N91-21449
LORBER, P. F. N91-21834
LORENA, LUIZ ANTONIO NOGUEIRA N91-21745
LOREY, DONALD A. N91-21119
LOSKUTOV, YU. M. N91-21822
LOTZ, MARK L. N91-21706
LOUGHRAN, L. B. N91-21970
LOW, EICHER N91-21153
LOW, F. J. N91-22004
LOWELL, JOHN R. N91-21486
LOWENGRUB, JOHN N91-21479
LU, HUEI-IIN N91-21450
LUDWIG, GERSON OTTO N91-21895
LUEBECK, EGMAR N91-21490
LUK, FRANKLIN T. N91-21759
LUMPKIN, A. H. N91-21865
LURIA, FRANK N91-22058
LURIA, M. N91-21667
LUU, JANE N91-22052
LYBANON, MATTHEW N91-21689

M

MAAOEY, ARVE N91-21161
MACGILL, R. A. N91-21291
MACH, H. N91-21237
MACINTOSH, ROBERT N91-21927
MACKNIGHT, WILLIAM J. N91-21319
MADHUKAR, A. N91-21934
MAEHLUM, BERNT N. N91-21166
MAIHARA, T. N91-22004
MAINE, TRINDEL A. N91-21446
MALKE, SUSANNE N91-21152
MALONE, T. W. N91-21287
MANCINI, D. N91-22041
MANES, K. R. N91-21504
MANGALAM, SIVARAMAKRISHNAN M. N91-21472
MANSFELD, FLORIAN N91-21301
MANTEUFFEL, T. A. N91-21462
MAO, MARLON N91-21097
MAR, MARK H. N91-21400
MARCOLINI, M. A. N91-21834
MARCUS, HARRIS L. N91-21298
MARGRAVE, JOHN L. N91-21344
MARLAND, G. H. N91-21634
MARSTON, PHILIP L. N91-21358
MARTELLI, F. N91-21082
MARTIN, R. C. N91-21626
MARTIN, RANDOLPH J., III N91-21650
MARTIN, ROBERT M. N91-22033
MARTINEAU, ROBERT R. N91-21302
MARTINIS, L. N91-22036
MARTINO, JOSEPH P. N91-21122
MARYNICK, DENNIS S. N91-21321
MARZULLO, KEITH N91-21770
MASI, SILVIA N91-21991
N91-22040
N91-22042
MASON, J. R. N91-21232
MASSON, COLIN N91-22009
MASSOUD, HISHAM Z. N91-21923
MASTERS, A. I. N91-21234
MASUR, H. N91-21237
MATHER, J. C. N91-21988
MATSCHINSKE, EMMA GIADA N91-21672
MATSUDA, Y. N91-21656
MATSUHARA, H. N91-22004
MATSUI, A. N91-21538
MATSUMOTO, H. N91-21888
MATTERN, DUANE N91-21137
MATTHEWS, D. N91-21488
MATTHEWS, PAUL N91-21958
MAYS, PETER N91-21805
MAZZEI, P. N91-21995
MAZZOCATO, MARIA EUGENIA N91-21620
MCADOO, DAVID C. N91-21595
MCBRATNEY, WILLIAM F. N91-21330
MCBRYAN, OLIVER A. N91-21764
MCCALLUM, DUNCAN C. N91-21208
MCCAUL, EDWARD N91-21207
MCCLINTON, CHARLES R. N91-21097
N91-21098
MCCLUNEY, DONALD SCOTT N91-21175
MCCOOL, TIMOTHY D. N91-21401
MCDONNELL, MICHAEL N91-21973
MCGARRITY, JOHN P. N91-21711
MCGAW, MICHAEL A. N91-21558
MCGRATH, W. R. N91-22017
MCGREGOR, W. K. N91-21142
MCINTOSH, GLEN E. N91-21197
MCNUTT, MARCIA K. N91-21591
N91-21592
MCRAE, D. S. N91-21478
MEEKS, E. L. N91-21489
MEI, XU N91-21648
MEI, Z. N91-21586
MELCHIORRI, B. N91-21991
MELCHIORRI, FRANCESCO N91-21991
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MELNICK, GARY J. N91-22023
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N91-22025
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MENDILLO, MICHAEL N91-21658
MENESES, PAULO ROBERTO N91-21608
MENTEN, KARL M. N91-22023
MENTZ, R. P. N91-21809
MERHAV, S. J. N91-21134
MERKLEY, D. R. N91-21372
MERLUZZI, P. N91-22036
MERRING, R. N91-21449
MESSEROTTI, M. N91-22064
MEYER, LOTHAR W. N91-21300
MEYER, MARION N91-21607
MEYER, PETER N91-22063
MEYERS, CAROL A. N91-21560
MEYERS, MARC A. N91-21300
MICHELASSI, V. N91-21082
MICHELS, H. H. N91-21858
MIFFLIN, ROBERT N91-21756
MIGLIORANZA, ELIANA N91-21615
MIILLER, A. P. N91-21347
MILAM, MALCOLM BRUCE N91-21525
MILANOVICH, F. P. N91-21498
MILES, M. J. N91-21395
MILGROME, O. N91-21436
MILLAR, TOM J. N91-22021
MILLER, IRVIN M. N91-21270
MILLER, MARTIN S. N91-21328
N91-21330
MILLER, R. J. N91-21675
MILLER, TIMOTHY L. N91-21450
MILLER, W. O. N91-21862
MILLER, W. T., JR. N91-21834
MINK, DOUGLAS J. N91-22053
MINSTER, J. BERNARD N91-21591
MIRELS, HAL N91-21878
MISOVEC, KATHLEEN M. N91-21193
MITCHELL, J. C. N91-21234

MITCHELL, JIM L. N91-21695
MITCHELL, KATHRYN L. N91-21961
MIYOSHI, HAJIME N91-21380
MIZUTANI, K. N91-22004
MOERNER, W. E. N91-21322
N91-21521
N91-21926
MOIN, PARVIZ N91-21470
MONAN, WILLIAM P. N91-21714
MONELL, DONALD W. N91-21214
MONGIA, H. C. N91-21081
MONTES, ANTONIO N91-21895
MONTGOMERY, J. A., JR. N91-21858
MONTGOMERY, RAYMOND C. N91-21186
MOORHEAD, JANE N91-21941
MORAN, P. J. N91-21296
MORENO, J. N91-21900
MORGAN, J. N91-21389
MORGAN, R. G. N91-21139
MOROSIN, B. N91-21914
MORRIS, BRIAN G. N91-21495
MORRIS, J. W., JR. N91-21586
MORRIS, P. J. N91-21086
MORRISON, CLYDE A. N91-21933
MORRISON, DENNIS R. N91-21701
MORSCHER, GREGORY N. N91-21309
MORSE, A. S. N91-21793
MORSE, T. F. N91-21281
MOSER, ROBERT D. N91-21470
MOSKOWITZ, IRA S. N91-21726
MOUGINIS-MARK, PETER N91-21593
MOUNTAIN, C. M. N91-22048
MUELLER, IVAN I. N91-21596
MUENCH, H. S. N91-21624
MUKUNDA, H. S. N91-21095
MULLER, DIETRICH N91-22063
MURPHY, G. P. N91-21835
MURRAY, ALEXANDER N91-22045
MURRAY, DUANE C. N91-21707
MURRAY, WILLIAM R. N91-21739
MURTAGH, D. N91-22050
MURTHY, P. L. N. N91-21562
MUTTON, PHILIP N91-21214

N

NAKAGAWA, T. N91-22004
NARAYAN, J. R. N91-21084
NAUMANN, K. W. N91-21107
N91-21151
NAZ, P. N91-21830
NEAGLE, B. N91-21502
NEINER, GEORGE N91-21116
NELSON, EMILY S. N91-21378
NEMAT-NASSER, SIA N91-21300
NEMLIKHER, YU. N91-21998
NERREN, BILLY H. N91-21545
NETO, ATAIR RIOS N91-21171
NETT, H. N91-21173
NETTLES, A. T. N91-21242
NEUFELD, DAVID A. N91-22024
N91-22025
NEUHAUS, P. N91-21350
NEUMARK, D. M. N91-21853
NEVESEPIPHANIO, JOSE CARLOS N91-21602
N91-21619
NG, LIAN L. N91-21099
NICHOLS, M. C. N91-21554
NICHOLSON, R. A. N91-21408
NIKNAFS, H. S. N91-21075
NISHI, NAOKI N91-21386
NISHIMURA, M. N91-21538
NISHIMURA, T. N91-22004
NIU, C. M. N91-21918
N91-21920
NIXON, D. N91-21120
NOGUCHI, MASAYOSHI N91-21113
NOMURA, HIROYOSHI N91-21785
NOMURA, Y. N91-21894
NONAKA, OSAMU N91-21112
N91-21113
NOOR, AHMED K. N91-21441
NORBURY, JOHN W. N91-21860
NORDEMANN, DANIEL JEAN ROGER N91-21847
NORDH, LENNART N91-22050
NORDINE, PAUL N91-21334
NORDINE, PAUL C. N91-21345
N91-21366
N91-21367
NORDTVEDT, KENNETH N91-21649
NOREM, NATHAN N91-21344
NORQUIST, P. D. N91-21815
NORRBAECK, MIKAEL N91-21976
NOYAN, I. C. N91-21589
NYLUND, NILS-OLAF N91-21546
NYMAN, LARS-AKE N91-22008

O

OCONNELL, RICHARD J. N91-21595
ODEN, J. T. N91-21239
OESTEVOLD, EINAR N91-21145
N91-21146
N91-21147
N91-21148
OGNEV, L. I. N91-21909
OHARA, TIMOTHY J. N91-21856
OHSAKA, K. N91-21359
OKADA, SHIN N91-21388
OKIISHI, T. H. N91-21115
OKUDA, HARUYUKI N91-21997
N91-22004
OLOFSSON , G. N91-22050
OLSEN, ERIK N91-21164
OLSON, STEVE N91-21697
OLSSON, ROBIN N91-21567
N91-21570
OMODA, KOICHIRO N91-21387
OMONT, A. N91-22007
ONLEY, D. S. N91-21842
ORKWIS, PAUL D. N91-21478
ORRHEDE, ANNA KARIN N91-21673
OUZTS, PETER J. N91-21140
OVERHAMM, MICHAEL N91-22045

P

PADILHA, ANTONIO LOPES N91-21651
PAEZ, T. L. N91-21583
N91-21804
PAHL, WOLFRAM N91-21490
PAI, DINESH K. N91-21550
PAISNER, J. A. N91-21511
PALM, HANS C. N91-21145
N91-21146
N91-21147
N91-21148
PALUMBO, DAVID B. N91-21954
PANITZ, CORINNA N91-21699
PANITZ, J. N91-21912
PANORA, R. N91-21389
PAPAGEORGIOU, DEMETRIOS T. N91-21454
PARADELLA, WALDIR RENATO N91-21613
PARADELLA, WALDIR REUATO N91-21617
PARAMESWARAN, VENKATARAMAN N91-21108
PARK, K. C. N91-21729
N91-21730
N91-21731
N91-21732
PARMENTIER, G. N91-21830
PARRINELLO, M. N91-21315
PARTANEN, JARNO N91-21705
PATZ, G. N91-21151
PAUGH, ROBERT L. N91-21392
PAULL, A. N91-21139
PAULUS, RICHARD A. N91-21409
PAYLOR, EARNEST D. N91-21592
PEARSON, D. N91-21320
PEDEN, JEFFERY H. N91-21789
N91-21790
N91-21791
PEEBLES, D. E. N91-21292
N91-21505
PEEBLES, H. C. N91-21505
PEEBLES, W. A. N91-21888
PEGG, D. J. N91-21850
PEKALA, R. W. N91-21312
PELTZER, GILLES N91-21591
PENDERGRAFT, ODIS C., JR. N91-21059
PENZ, P. ANDREW N91-21782
PEPPER, DARRELL W. N91-21079
PERAIRE, J. N91-21101
PERAIRE, JAIME N91-21463
PEREPEZKO, J. H. N91-21339
PERREAULT, G. C. N91-21305
PERRY, RONALD B. N91-21257
PERSAD, C. N91-21298
PETERS, D. N91-21488
PETERS, JOHN W. N91-21430
PETERSEN, DIETER N91-21254
PETERSEN, J. J. N91-21825
PETITON, SERGE N91-21724
PETRIE, T. W. N91-21887
PETRO, ANDREW J. N91-21222
PETTY, GRANT W. N91-21664
PHAN, MINH N91-21573
N91-21575
PHILIPONA, R. N91-21888
PHILLIPS, MARY A. N91-21299
PHILLIPS, ROGER J. N91-21597
PHILLIPS, THOMAS G. N91-22019
N91-22023
N91-22032
PICCIRILLO, LUCIO N91-22036
PICONE, J. M. N91-21421
PIDD, M. N91-21460
PIEHLER, D. N91-21913
PIERI, DAVID C. N91-21593
PIEUCHOTDERAVISY, G. N91-21174
PILCHEN, GUY N91-21744
PILCHOWSKI, HANS-ULRICH N91-21215
PINELLI, THOMAS E. N91-21959
PINKEL, D. N91-21488
PINKNEY, J. N91-21460
PITTS, L. H. N91-21964
PITZ, W. J. N91-21273
PIZZO, LICIA N91-22036
PLAETSCHKE, ERMIN N91-21108
PLATEAU, G. N91-21745
POCKLINGTON, TONY N91-21956
POGLITSCH, ALBRECHT N91-21996
N91-22005
POITRAST, BRUCE J. N91-21717
POMERANTZ, MARTIN N91-21321
POORE, AUBREY B. N91-21769
POPE, S. B. N91-21080
N91-21081
PORDAL, H. S. N91-21068
PORRO, A. R. N91-21085
PORTANOVA, P. L. N91-21178
POVINELLI, LOUIS A. N91-21071
N91-21082
N91-21447
N91-21458
PRESCOTT, WILLIAM H. N91-21591
PRESTA, R. W. N91-21511
PROCTOR, DAVID R. N91-21943
PROVINCE, M. A. N91-21398
PRUETT, C. DAVID N91-21099
PUGET, JEAN-LOUP N91-22028
PUGH, TED N91-21399
PURDOM, J. F. W. N91-21666
PUTTERMAN, S. N91-21355

Q

QIAN, Y.-T. N91-21920

R

RABAS, T. N91-21449
RADEKA, V. N91-21873
RADICATIDIBROZOLO, GUISEPPE N91-21805
RADZIMSKI, Z. J. N91-21912
RAIS, JACUB N91-21599
RAJ, R. N91-21928
RAJESHWAR, KRISHNAN N91-21321
RAMOS, J. I. N91-21461
RAMPINO, MICHAEL R. N91-21642
N91-21643
RANDAZZO, PHILIP N91-21833
RAO, DANTAM K. N91-21211
RAO, KONDAPALLI RAMA N91-21169
RAPP, RICHARD H. N91-21597
RATTNER, JUSTIN N91-21758
RAWAL, D. N91-21209
N91-21210
RAY, J. D. N91-21667
RAY, S. N. N91-21670
RAYMOND, P. N91-21799
RAYNAUD, G. N91-21174
RAZANI, A. N91-21280
REBUT, P. H. N91-21897
REDDY, S. N91-21205
REED, WILMER H., III N91-21176
REICHERT, B. A. N91-21115
REIF, JOHN H. N91-21499
REIGHBER, CHRISTOPHER N91-21599
REILINGER, ROBERT E. N91-21591
REISENTHEL, P. N91-21120
RENATOPARADELLA, WALDIR N91-21608
RENAUD, EARL W. N91-21066
RESHOTKO, E. N91-21061
REY, CHARLES A. N91-21372
REYNOLDS, JOHN R. N91-21321
REYNOLDS, R. W. N91-21669
RHIM, WON-KYU N91-21352
N91-21370
RIBEIRODOSSANTOS, ATHOS N91-21610
RICHARDSON, K. N91-21676
N91-21681
RICHTER, JUERGEN H. N91-21404
RIEDEL, P. S. N91-21618

RIEGLER, JOSEPH T. N91-21718
RIFKIN, ADAM N91-21724
RIGGINS, DAVID W. N91-21097
RILEY, TIMOTHY J. N91-21396
N91-21397
RINGSET, VIDAR N91-21164
RISSER, S. M. N91-21310
N91-21313
RIZZA, ROBERT J. N91-21755
ROBERTODOSSANTOS, JOAO N91-21605
N91-21611
ROBERTSON, JAMES B. N91-21911
ROBINSON, ALLAN R. N91-21693
ROBINSON, JEFFREY D. N91-21737
ROBOCK, ALAN N91-21646
ROBSON, IAN N91-22000
ROE, J. N91-21498
ROENNEKLEIV, ARNE N91-21164
ROESER, HANS PETER N91-22013
N91-22014
N91-22047
ROGERS, R. C. N91-21139
ROHARDT, CLAAS-HINRIK N91-21466
ROLAND, J. N91-21999
ROMALEWSKI, ROBERT S. N91-21689
ROSE, M. N91-21512
ROSE, WILLIAM N91-21593
ROSEN, M. N91-21488
ROSEN, RICHARD D. N91-21596
ROSENBAUM, NATHAN N91-21969
ROSS, DUNCAN B. N91-21677
ROSSI, L. N91-22036
ROTH, DON J. N91-21553
ROTH, JOHN T. N91-21684
ROTTLER, J. S. N91-21740
ROUHI, M. N91-21563
ROY, R. N91-21517
ROYDEN, LEIGH N91-21591
ROZGONYI, G. A. N91-21912
RUBIN, C. A. N91-21526
RUBIN, S. G. N91-21068
N91-21093
RUCKER, MICHELLE A. N91-21157
RUDNICK, J. N91-21376
RUDY, DAVID H. N91-21087
RUGGLES, STEPHEN L. N91-21435
RUIJGROK, T. W. N91-21798
RUIZ, C. N91-21244
N91-21246
N91-21249
RUKAVICIN, A. N91-21998
RUMITZ, M. N91-22005
RUMMEL, REINHARD F. N91-21597
RUNDLE, JOHN B. N91-21591
RUSSELL, JAMES W. N91-21183
RUTKOWSKI, H. L. N91-21902

S

SABAKA, T. J. N91-21654
SABETFAKHRI, K. N91-21835
SACCO, G. P. N91-21198
SACK, C. H. N91-21886
SAFA, HELENE N91-22039
SAFFMAN, P. G. N91-21477
SAGER, G. T. N91-21887
SAGOVAC, CHRISTOPHER P. N91-21227
SAKAMOTO, SEIICHI N91-22051
SALOPEK, D. S. N91-21655
SALTZ, JOEL N91-21724
SAMORA, C. N91-21398
SAMPSON, C. R. N91-21675
SAMUELSSON, INGEMAR N91-21109
SANCHEZ, N. N91-21989
SANDERS, DAVID B. N91-21994
SANDERS, DONALD C. N91-21708
SANDS, O. S. N91-21417
SANDWELL, DAVID T. N91-21592
SANI, R. L. N91-21452
SANTILLO, C. N91-22036
SANUKI, H. N91-21893
SARGENT, M., III N91-21512
SAROYAN, R. A. N91-21554
SARYAN, L. N91-21628
SASSE, RONALD A. N91-21330
SATHUVALLI, UDAYA B. N91-21377
SATTERFIELD, C. N. N91-21272
SAUBER, JEANNE M. N91-21591
SAUNDERS, THOMAS E. N91-21241
SAUSEN, TANIA MARIA N91-21620
SAWANT, H. S. N91-22064
SAXON, ROBERTA P. N91-21852
SCARAMUZZI, F. N91-22042
SCHAAF, CRYSTAL B. N91-21624
SCHAEFER, R. N91-21449
SCHAFFAR, M. N91-21832
SCHAUS, C. F. N91-21510
SCHEINES, RICHARD N91-21794
SCHIEDER, R. N91-22025
N91-22034
SCHIFFMAN, ROBERT A. N91-21345
N91-21366
N91-21367
SCHISSEL, D. P. N91-21887
SCHLEINITZ, JUERGEN P. N91-21181
SCHMALZER, PAUL A. N91-21635
SCHMID-BURGK, JOHANNES N91-22013
N91-22014
N91-22047
SCHMIDT, C. W. N91-21848
SCHMIDT, H.-W. N91-21320
SCHMIDT, HANNS-LUDWIG N91-21856
SCHMIDT, W. N91-21464
SCHORR, HERBERT N91-21727
SCHOTZ, STEVEN S. N91-21661
N91-21662
N91-21663
SCHRYER, DAVID R. N91-21270
SCHUCH, LUIZ ALEXANDRE N91-21847
SCHUETZER, ELIZABETH N91-21967
SCHUHMANN, WOLFGANG N91-21856
SCHULTZ, KEVIN L. N91-21974
SCHUNK, P. R. N91-21872
SCHUTZ, ROBERT E. N91-21596
SCHWAAB, GERHARD W. N91-22013
N91-22014
N91-22047
SCHWARZ, RAY P. N91-21700
SCIALDONE, JOHN J. N91-21255
SCIAMMARELLA, CESAR A. N91-21492
SCOTT, J. C. N91-21322
SCOTT, JAMES R. N91-21060
N91-21067
SCULLY, J. R. N91-21292
SEAGER, C. H. N91-21912
SEEGER, HERMAN N91-21599
SEGALMAN, D. J. N91-21565
SEGERSTAHL, BORIS N91-21622
SEHGAL, A. K. N91-21117
SEKAR, B. N91-21084
N91-21095
SELF, STEPHEN N91-21593
SELIG, W. S. N91-21276
SEO, Y. N91-21444
SEPIOL, B. N91-21890
SERAFINO, KAREN M. N91-21761
SERAJI, HOMAYOUN N91-21544
SERAYDARIAN, R. P N91-21888
SHABUROV, V. A. N91-21908
SHAFFER, S. J. N91-21290
SHAHINPOOR, M. N91-21280
SHAKKOTTAI, P. N91-21264
SHANNON, DAVID T., JR. N91-21225
SHANNON, R. R. N91-21875
SHAPIRO, A. B. N91-21584
SHARP, G. RICHARD N91-21185
SHAW, M. J. N91-21509
N91-21511
SHEA, D. J. N91-21669
SHELDON, B. W. N91-21304
SHEPHERD, DENNIS G. N91-21625
SHERIDAN, PHILIP L. N91-21221
SHIBAI, HIROSHI N91-22004
SHIMABUKURO, YOSIO EDEMIR N91-21611
SHINE, M. C. N91-21586
SHOLOMITSKII, G. B. N91-21993
SHU, CHI-WANG N91-21456
N91-21801
SHUART, MARK J. N91-21560
SHULL, R. N. N91-21128
SHYY, W. N91-21076
SIEGEL, P. H. N91-22017
SIEGFRIED, W. N91-21599
SIEKHAUS, W. J. N91-21274
SIGNORE, M. N91-21989
SIGURDSSON, HARALDUR N91-21644
SIMCHICK, RICHARD T. N91-21373
SINGH, A. K. N91-21317
SINGH, D. J. N91-21088
N91-21117
SINGHAL, S. N. N91-21562
SIQUIG, RICHARD A. N91-21124
N91-21677
SIROVICH, L. N91-21453
SKALARE, A. N91-22046
SKELTON, ROBERT E. N91-21572
SKINN, DONALD A. N91-21122
SKOBELEV, V. V. N91-21822
SKULACHEV, D. N91-21998
SLINEY, HAROLD E. N91-21302
SLOCUM, A. H. N91-21196
SMALLEY, R. E. N91-21261
SMEETS, G. N91-21107
N91-21151
SMEULDERS, P. N91-21885
SMIRNOV, YU. P. N91-21908
SMITH, A. F. N91-21810
SMITH, DAVID E. N91-21597
SMITH, EDWYN D. N91-21426
SMITH, G. P. N91-21262
SMITH, J. H. B. N91-21460
SMITH, JEROME A. N91-21694
SMITH, M. T. N91-21251
SMITH, P. N91-21320
SMITH, R. C. N91-21796
SMITH, RICHARD D. N91-21476
SMITH, STEVEN D. N91-21671
SMITH, SUZANNE WEAVER N91-21213
SMITH, T. J. N91-21868
SMITH, TODD E. N91-21138
SMYLIE, DOUGLAS E. N91-21595
SMYRLIS, YIORGOS S. N91-21454
SNOOK, J. S. N91-21666
SNYDER, AARON N91-21090
SODERMAN, PAUL T. N91-21828
SOERENSEN, PAAL N91-21160
SOHN, K. H. N91-21061
SORENSEN, STEVE N91-21794
SOUTHWICK, R. D. N91-21232
SOVESTNOV, A. E. N91-21908
SPENCER, DONALD J. N91-21878
SPEZIALE, C. G. N91-21451
SPIRTES, PETER N91-21794
SPRANGLE, P. N91-21444
SPREITZER, MIKE N91-21425
SQUILLANTE, MICHAEL R. N91-21212
SRINIVASAN-RAO, T. N91-21513
N91-21515
N91-21873
STACEY, GORDON J. N91-21996
N91-22005
STACK, JOHN P. N91-21472
STARK, ANTONY A. N91-22035
STARK, RONALD N91-22029
STARNES, JAMES H., JR. N91-21561
START, D. F. H. N91-21886
STAUDENMEIER, J. L. N91-21901
STEELE, C. L. N91-21408
STEELE, L. P. N91-21626
STEFFES, PAUL G. N91-22057
STEGER, JOSEPH L. N91-21063
N91-21464
STEIN, W. N91-21508
STELL, GEORGE N91-21475
STEPHENS, S. E. N91-21141
STEPPE, H. N91-22007
STERN, ROBERT J. N91-21592
STEUCK, KURT N91-21944
STEVENS, D. F. N91-21968
STINCHCOMBE, MAXWELL N91-21780
STJOHN, H. E. N91-21887
STOCK, S. R. N91-21554
STOECHER, MICHAEL N91-21165
STOLL, FREDERICK N91-21561
STOLTZFUS, JOEL M. N91-21157
STONE, G. N91-21488
STORHAUG, GEIR A. N91-21145
N91-21146
N91-21147
N91-21148
STOUT, R. B. N91-21497
STOWE, FRANCIS S. N91-21410
STRATAKIS, K. N91-21835
STRAUSS, B. S. N91-21702
STRAYER, W. TIMOTHY N91-21403
STROCK, THOMAS W. N91-21116
STRUKOV, IGOR N91-21998
SUENAGA, M. N91-21916
SUMAKER!S, JOE N91-21927
SUN, LIN N91-21487
SUN, S. N91-21510
SUNABE, K. N91-21866
SUNADA, K. N91-22051
SUNEPEREZ, JUAN N91-21747
SURYANARAYANA, P. V. R. N91-21346
N91-21377
SUTTON, E. C. N91-22015
SWANSON, M. B. N91-21629
SWIFT, L. W. N91-21632
SWIMM, RANDALL T. N91-21879
SWITZER, G. F. N91-21089
SWORDY, SIMON N91-22063
SYMON, JAMES R. N91-21784

T

TAI, A. N91-21502
TAKAGI, SHOHEI N91-21491
TAKAMURA, MORIYUKI N91-21388
TAKASAWA, KINGO N91-21112
TAN, CHOON S. N91-21066
TANAKA, ATSUSHIGE N91-21381
TANAKA, KEIKO N91-21126
TANAKA, KOHEI N91-21383
TANAKA, TERUO N91-21387
TANG, CHA-MEI N91-21519
TANGA, A. N91-21883
TANIOKA, TADAYUKI N91-21384
TANVEER, S. N91-21455
TAPLEY, BYRON D. N91-21597
TARNOFF, PHILIP J. N91-21399
TARONI, A. N91-21886
TARREL, RICHARD J. N91-21121
TATE, ATSUSHI N91-21111
TAVARESDEMATTOS, JUERCIO N91-21608
TAYLOR, K. J. N91-21261
TAYLOR, M. E. C. N91-21245
N91-21247
TEETS, ALAN R. N91-21327
TEH, H. H. N91-21781
TEIXEIRA, RICHARD A. N91-21721
TENCH, R. J. N91-21274
TEREKHOV, G. I. N91-21908
TERVO, MATTI N91-21622
TETER, JOHN E., JR. N91-21556
THANGAM, S. N91-21451
THOM, R. N91-21532
THOMAS, E. V. N91-21314
THOMAS, JAMES L. N91-21087
THOMAS, P. R. N91-21884
THOMAS, ROBERT H. N91-21640
THOMPSON, G. E. N91-21294
THOMPSON, S. L. N91-21518
THOMPSON, STEVEN R. N91-21299
THOMPSON, T. C. N91-21862
THORS, P. N91-21449
THRONSON, H. A. N91-22048
TIDJANI, M. E. N91-21907
TISCHLER, M. B. N91-21134
TITZ, RUTH U. N91-22013
N91-22014
N91-22047
TIWARI, S. N. N91-21088
N91-21117
TOFFOLATTI, L. N91-21995
TOLBERT, L. M. N91-21316
TOLLS, VOLKER N91-22034
TOLMUNEN, T. N91-22017
TOMANEK, DAVID N91-21285
TOMEI, E. J., JR. N91-21178
TORBO, PER N91-21159
TORTI, RICHARD N91-21191
TOTH, CS. N91-21514
TOVERUD, MORTEN N91-21161
TOWN, J. P. N91-21985
TOWNES, CHARLES H. N91-21996
N91-22005
TOWNSEND, DENNIS P. N91-21534
TOWNSEND, LAWRENCE W. N91-21860
TRAN, DUONG HIEN N91-21571
TRAN, JEAN-MARIE Q. N91-21414
N91-21415
N91-21692
TREBES, J. N91-21488
TRENBERTH, K. E. N91-21669
TREVISAN, R. H. N91-22064
TRINH, E. H. N91-21331
N91-21341
N91-21359
TRIPP, JOHN S. N91-21199
TRIVEDI, ANIL N. N91-21190
TRIVEDI, NALIN BABULAL N91-21651
N91-22060
TROUTMAN, PATRICK A. N91-21214
TRUMPER, DAVID L. N91-21196
N91-21204
TRUSKOWSKI, JOSEPH W. N91-21258
TSAGAROPOULOS, G. N91-21918
TSAI, Y.-L. PETER N91-21094
TSANG, T. N91-21513
N91-21515
N91-21873
TSUI, T. L. N91-21675
TU, YU K. N91-21534
TUCKER, G. E. N91-21134
TUEGEL, L. M. N91-21235
TUNDISI, JOSE GALISIA N91-21603
TURCHI, P. E. A. N91-21915
TURCO, RICHARD N91-21645
TURNAU, J. N91-21845
TURNER, JAMES ERIC N91-21175
TWIEG, R. J. N91-21322
TWORZYDLO, W. N91-21239
TYSELL, LARS G. N91-21110
TYUNIS, A. V. N91-21908
TZOU, Y. N91-21928
TZVI, GAL-CHEN N91-21648

U

UHLMANN, JEFFREY K. N91-21421
ULRICH, DIETER N91-21490
UPCHURCH, BILLY T. N91-21270

V

VADAKETH, S. N91-21239
VALDEZ, J. G. N91-21275
VALLETTE, B. J. N91-21670
VANBUSKIRK, PAUL D. N91-21493
VANDESTADT, HERMAN N91-22046
VANES, J. T. N91-21431
N91-21863
VANLEER, BRAM N91-21073
VANNORMAN, JOHN D. N91-21270
VANOVERBEKE, THOMAS N91-21448
VANVEEN, BARRY D. N91-21876
VAUGHAN, C. T. N91-21773
VAWTER, G. A. N91-21510
VEDOVELLO, RICARDO N91-21606
VENABLES, J. A. N91-21932
VERKOOIJEN, H. N91-21431
VICROY, DAN D. N91-21132
VICTORINODEFRANCA, GERALDO N91-21602
VIDDAL, V. N91-21163
VIEIRADUTRA, LUCIANO N91-21608
VIG, JOHN R. N91-21445
VILLARREAL, JAMES N91-21778
VITKAVAGE, SUSAN C. N91-21923
VITORELLO, ICARO N91-21608
N91-21651
VONLAVANTE, E. N91-21795
VSHIVTSEV, A. S. N91-21822

W

WAHR, JOHN M. N91-21596
WAKAMI, NOBORU N91-21785
WALKER, K. P. N91-21797
WALLACE, JOHN N91-21362
WALMSLEY, CHARLES MALCOLM N91-22007
WALSH, JOANNE L. N91-21580
WALTER, LOUIS S. N91-21641
WALTER, RICHARD T. N91-21493
WANG, C. R. N91-21085
WANG, LUI N91-21956
WANG, P. Z. N91-21781
WANG, SHIH-LIANG N91-21548
WANG, SU YING N91-22045
WANG, T. G. N91-21375
WANHAINEN, JOYCE S. N91-21185
WARD, JOAN M. N91-21624
WARD, MICHAEL A. N91-21533
WARNER, NORMAN N91-21709
WARREN, BRUCE A. N91-21947
WARREN, M. E. N91-21510
WARREN, R. C. N91-21326
WATANABE, HIROYUKI N91-21784
WEAVER, ALFRED C. N91-21403
N91-21741
N91-21789
N91-21966
WEBB, JAMES T. N91-21710
WEBER, J. K. RICHARD N91-21345
N91-21366
N91-21367
WEBER, WILLIAM F. N91-21493
WEI, CAI N91-21801
WEIN, JOEL N91-21775
WEINBERG, MICHAEL C. N91-21340
WEINER, M. M. N91-21416
WELCH, D. O. N91-21916
WELCH, R. N. N91-21680
WELCH, SHARON S. N91-21186
WELDON, WILLIAM F. N91-21298
WENDT, M. N91-21139
WERBY, M. F. N91-21837
N91-21838
WERLE, HENRI N91-21465
WERNER, U. N91-21237
WESTBROOK, C. K. N91-21273
WETZIG, VOLKER N91-21490
WHILE, D. M. N91-21179
N91-21180
WHINNERY, JAMES E. N91-21707
WHIRLEY, R. G. N91-21584
WHITE, D. A. N91-21402
WHITE, HALBERT N91-21780
WHITE, R. K. N91-21402
WHITLATCH, W. N91-21668
WHITTENBERGER, J. DANIEL N91-21302
WICKRAMASINGHE, N. C. N91-21992
WIECZOREK, JOHANNES N91-21601
WIJNBERGEN, JAN J. N91-22026
WILBUR, PAUL J. N91-21880
WILBURN, ANNE MARIE N91-21685
WILDE, PETER N91-21467
N91-21468
WILLIAMS, EDWARD M. N91-21760
WILLIAMS, G. N91-21355
WILLIAMS, JOHN D. N91-21880
WILLIAMS, RICHARD S. N91-21594
WILLIS, W. J. N91-21873
WILLNECKER, R. N91-21348
N91-21349
N91-21350
WILLS, ROBERT W. N91-21435
WILSON, CHARLES R. N91-21596
WILSON, JOHN W. N91-21860
WILSON, JOSEPH J. N91-21122
WILSON, ROBERT N91-22018
WILSON, THOMAS L. N91-22030
WINNEWISSER, G. N91-22034
WISCHMANN, K. B. N91-21303
N91-21314
WISE, M. B. N91-21278
WITT, ARTHUR N91-21671
WITTEKOPF, REINER N91-21490
WOLD, A. N91-21918
WOLD, W. N91-21919
WOLF, DAVID A. N91-21700
WOLKE, PATRICK J. N91-21189
WOOD, CHARLES A. N91-21593
WOOD, G. C. N91-21294
WOOD, MARK D. N91-21770
WOOL, R. P. N91-21318
WORTHEM, DENNIS W. N91-21252
WRIGHT, L. E. N91-21842
WRIGHT, MARGARET B. N91-21762
WU, P. N91-21919
WU, SHIH-CHIN N91-21573
WU, Z. Q. N91-21781

X

XIA, ZULE N91-21207
XIE, M. N91-21508
XU, MEI N91-21665

Y

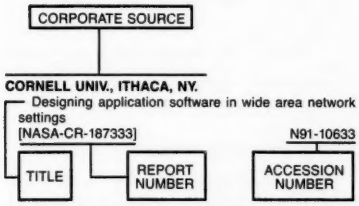
YACOUB, H. N91-21628
YAMADA, H. N91-21891
YANG, L. F. N91-21576
YANG, R.-J. N91-21070
YANG, S. N91-21920
YARIV, AMNON N91-21917
YARKONY, DAVID R. N91-21854
YASUI, S. N91-21866
YEN, JOHN N91-21788
YODER, CHARLES F. N91-21595
YORKEY, T. N91-21488
YOSHINAGA, TAKASHI N91-21111
YOUCEF-TOUMI, K. N91-21205
YOUNG, LAWRENCE E. N91-21621
YU, P. Y. N91-21906
YULE, H. P. N91-21748

Z

ZAKRAJSEK, JAMES J. N91-21534
ZAMAN, K. B. M. Q. N91-21061
ZAMLUTTI, C. J. N91-21807
ZAPATA, L. E. N91-21504
ZAPOTOSKY, JOUN E. N91-21419
ZDUNEK, ADAM N91-21568
N91-21569
ZENIOS, STAVROS N91-21775
ZHANG, JOHN G. N91-21212
ZHAO, JINGXIA N91-21674
ZHENG, HAO N91-21687
ZHOU, T. Q. N91-21912
ZHU, MEI N91-21474
ZIMMERMAN, G. B. N91-21808
ZIOCK, H. J. N91-21862
ZLOBEC, P. N91-22064
ZLOTNICK, VICTOR N91-21597
ZOLTANI, C. K. N91-21484

ZUNIGA, MIGUEL R. N91-21421
ZWASS, SAMUEL N91-21430

Typical Corporate Source Index Listing



Listings in this index are arranged alphabetically by corporate source. The title of the document provides the user with a brief description of the subject matter. The report number helps to indicate the type of document cited (e.g., NASA report, translation, NASA contractor report). The accession number denotes the number by which the citation is identified. The titles are arranged under each corporate source in ascending accession number order.

A

ACADEMY OF SCIENCES (USSR), LENINGRAD.
Double 4f-collapse in Ce(0.9-x)Yb(x)Th(0.1)
[DE91-619752] N91-21908

ACADEMY OF SCIENCES (USSR), MOSCOW.
Submillimeter astronomy and cosmological tests N91-21993
RELICT 2 project: Scientific program and structure N91-21998

ADVANCED PROJECTS RESEARCH, INC., MOORPARK, CA.
A multidimensional finite element method for CFD N91-21079

ADVISORY GROUP FOR AEROSPACE RESEARCH AND DEVELOPMENT, NEUILLY-SUR-SEINE (FRANCE).
Rotary-balance testing for aircraft dynamics
[AGARD-AR-265] N91-21156
Radio wave propagation modeling, prediction and assessment
[AGARD-AG-326] N91-21404
Application of mesh generation to complex 3-D configurations
[AGARD-AR-268] N91-21464
High G physiological protection training
[AGARD-AG-322] N91-21720

AEROMETRICS, INC., MOUNTAIN VIEW, CA.
An experimental investigation of circulation control flow fields using holographic interferometry
[NASA-CR-166482] N91-21459

AERONAUTICAL RESEARCH INST. OF SWEDEN, STOCKHOLM.
Low speed wind tunnel investigation of propeller slipstream aerodynamic effects on different nacelle/wing combinations. Part 2: Propeller slipstream flow field surveys (velocity components, dynamic, total and static pressure distributions) at zero angle of attack and high power
[FFA-TN-1990-24-PT-2] N91-21109
MATGRID, a program for generation of C-H and C-O topology grids around wing/body configurations: User's guide
[FFA-TN-1991-03] N91-21110
On the mapping properties of boundary integral operators for Navier-Stokes like equations
[FFA-TN-1989-41] N91-21467
Existence and uniqueness results for problems arising in connection with the incompressible Navier-Stokes equations
[FFA-TN-1989-43] N91-21468
Some treatments on boundary conditions for quasi one-dimensional Euler equations
[FFA-TN-1990-36] N91-21469
Contributions to the analysis of the DCB-specimen
[FFA-TN-1990-22] N91-21567
Stability analysis of a fuselage side
[FFA-TN-1990-32] N91-21568
Application of the p-version FE method to geometrically non-linear problems in three dimensions
[FFA-TN-1990-33] N91-21569
Mode 1 interlaminar fracture toughness of carbon/PEEK participation in an international round robin program
[FFA-TN-1990-41] N91-21570

AEROSPACE CORP., EL SEGUNDO, CA.
Quality function deployment in launch operations
[AD-A230983] N91-21178
Tribological performance and deformation of sputter-deposited MoS2 solid lubricant films during sliding wear and indentation contact
[AD-A231003] N91-21547
Transverse flow gas lens
[AD-A231366] N91-21878
Subthreshold I-V characteristics of AlGaAs/GaAs MODFETs: The role of unintentional acceptors
[AD-A230110] N91-21904

AIR FORCE ACADEMY, CO.
Experimental response functions and response matrices for 2.54-cm x 2.54 cm and 7.62 cm x 7.62 cm bismuth germanate scintillation detectors
[AD-A230140] N91-21486

AIR FORCE GEOPHYSICS LAB., HANSCOM AFB, MA.
The hemispheric eighth mesh terrain elevation and geography data sets
[AD-A231592] N91-21624
Power spectra of internal gravity waves
[AD-A231596] N91-21659

AIR FORCE HUMAN RESOURCES LAB., BROOKS AFB, TX.
A conceptual model of the performance of the United States Air Force flight training program
[AD-A230881] N91-21711
Computer-assisted knowledge acquisition for hypermedia systems N91-21944

AIR FORCE HUMAN RESOURCES LAB., WRIGHT-PATTERSON AFB, OH.
Decision support environment for concurrent engineering requirements
[AD-A230899] N91-21555

AIR FORCE INST. OF TECH., WRIGHT-PATTERSON AFB, OH.
Bifurcation analysis of the longitudinal dynamics of a simple powered lifting hypersonic vehicle
[AD-A230826] N91-21118
Vortex bursting over a unit area aspect ratio delta wing using vortex paneling methods
[AD-A231028] N91-21119
Entry vehicle performance analysis and atmospheric guidance algorithm for precision landing on Mars
[AD-A231585] N91-21228
Material properties of silicon carbide fibers with continuously applied sol-gel alumina coatings
[AD-A230825] N91-21256
Impact damage in curved graphite/epoxy panels with clamped edges
[AD-A230853] N91-21257
Fracture toughness of unidirectional fiber reinforced ceramic composites in Mode 2 utilizing laser interferometry
[AD-A231027] N91-21258
Transverse cracking in a fiber reinforced ceramic matrix composite
[AD-A231029] N91-21259
Analysis and testing of a bistatic radar cross section measurement capability for the AFIT anechoic chamber
[AD-A230609] N91-21401
Speech recognition using Kohonen neural networks, dynamic programming, and multi-feature fusion
[AD-A230951] N91-21410
An empirical study of combining communicating processes in a parallel discrete event simulation
[AD-A230982] N91-21412
Application of the finite element method to random rough surface scattering with Neumann boundary conditions
[AD-A231583] N91-21420
Using the USU ionospheric model to predict radio propagation through a simulated ionosphere
[AD-A231599] N91-21423
Silicon hybrid Wafer Scale Integration (WSI) used to fabricate a Hilbert transform integrated circuit module
[AD-A230605] N91-21428
Numerical approximations of the Green's functions for a theoretical model of an aperture fed stacked-patch microstrip antenna
[AD-A230702] N91-21429
Kalman filter tracking of a reflective target using forward looking infrared measurements and laser illumination
[AD-A231196] N91-21524
Sinusoidal response of a thin viscoplastic plate with severe temperature gradient
[AD-A230938] N91-21588
A search for episodic increases in upper atmospheric water vapor as evidence of an extraterrestrial source
[AD-A231598] N91-21660
Features of the Raleigh tornadic storm based on analysis of damage
[AD-A231601] N91-21684
A linear quadratic regulator weight selection algorithm for robust pole assignment
[AD-A230596] N91-21737
Determining concurrency in object-oriented design of real-time embedded systems using Ada
[AD-A230659] N91-21738
An empirical evaluation of analytical models for parallel relational database queries
[AD-A230813] N91-21752
An object oriented design and implementation of the IDEF(sub 0) essential model using Ada and an Ada based expert system
[AD-A230814] N91-21753
A remote visual interface tool for simulation control and display
[AD-A231019] N91-21754
An object-oriented military simulation baseline for parallel simulation research
[AD-A231030] N91-21755
Graphical representation of parallel algorithmic processes
[AD-A231258] N91-21760
Computing with neural networks: A comparison of the multi-layer perceptron and the hierarchical pattern recognition network for classification problems
[AD-A231584] N91-21768
Access and operator methods for the Triton nested relational database system
[AD-A230608] N91-21962
Analysis of periodic orbits about the Martian moons by continuation techniques
[AD-A231026] N91-22058

AIR FORCE OCCUPATIONAL AND ENVIRONMENTAL HEALTH LAB., BROOKS AFB, TX.
Recommended carbon dioxide and relative humidity levels for maintaining acceptable indoor air quality
[AD-A230026] N91-21717

AIR FORCE SYSTEMS COMMAND, WRIGHT-PATTERSON AFB, OH.
The energy source rocket of the Soviet Union
[AD-A224938] N91-21229

AIR WAR COLL., MAXWELL AFB, AL.
Top quality management, reliability, and maintainability: Institutional goals with built in barriers
[AD-A230134] N91-21552

AIR WEATHER SERVICE, SCOTT AFB, IL.
Convective scale dynamics
[AD-A231567] N91-21683

AIRESEARCH MFG. CO., LOS ANGELES, CA.
Advanced magnetic suspensions for vibration isolation and fast-attitude control of space-based generic pointing mounts N91-21190

AKRON UNIV., OH.
Cost-effective accurate coarse-grid method for highly convective multidimensional unsteady flows N91-21075

ALLIED-SIGNAL AEROSPACE CO., KANSAS CITY, MO.
Resistance seam welding thin copper foils
[DE91-008988] N91-21535

AMES LAB., IA.
Enhanced selectivity and detectability in absorption and fluorescence methods based on polarization modulation
[DE91-008926] N91-21279

AMSTERDAM UNIV. (NETHERLANDS).
Late-type stars at far-infrared and sub-millimeter wavelengths N91-22006
ANALYTICAL MECHANICS ASSOCIATES, INC., HAMPTON, VA.
Power optimal single-axis articulating strategies
[NASA-CR-187510] N91-21581
ANALYTICAL SERVICES AND MATERIALS, INC., HAMPTON, VA.
Computation of turbulent high speed mixing layers using a two-equation turbulence model N91-21084
Zonal analysis of two high-speed inlets N91-21089
ARC PROFESSIONAL SERVICE GROUP, INC., ROCKVILLE, MD.
Test report for photonic sensors used in electric field measurement of simulated electromagnetic pulses
[AD-A231597] N91-21422
ARGONNE NATIONAL LAB., IL.
Analytical chemistry laboratory
[DE91-008986] N91-21266
Heat-rate improvements obtained with the use of enhanced tubes in surface condensers
[DE91-006565] N91-21449
Dynamic tube/support interaction in heat exchanger tubes
[DE91-006089] N91-21582
Automated computer software development standards enforcement
[DE91-007328] N91-21748
Functional specifications for mathematical computations
[DE91-006002] N91-21803
ARIZONA STATE UNIV., TEMPE.
A center for the study of early events in photosynthesis
[DE91-008509] N91-21698
In-situ diffraction and imaging studies of heteroepitaxial growth of semi-conductors
[AD-A231568] N91-21932
ARIZONA UNIV., TUCSON.
Containerless synthesis of interesting glasses N91-21340
Report of the panel on lithospheric structure and evolution, section 3 N91-21592
Research in optical sciences
[AD-A230964] N91-21875
ARMENIAN ENGINEERS AND SCIENTISTS OF AMERICA, INC., GLENDALE, CA.
Environment fact finding mission report
[PB91-130369] N91-21628
ARMY AVIATION SYSTEMS COMMAND, CLEVELAND, OH.
Mechanical behavior of fiber reinforced SiC/RBSN ceramic matrix composites: Theory and experiment
[NASA-TM-103688] N91-21243
Advanced rotorcraft transmission program
[NASA-TM-103276] N91-21531
Effects of gear box vibration and mass imbalance on the dynamics of multi-stage gear transmissions
[NASA-TM-103695] N91-21534
ARMY BELVOIR RESEARCH AND DEVELOPMENT CENTER, FORT BELVOIR, VA.
Elastomer compatibility with liquid propellant at elevated temperature
[AD-A230973] N91-21327
ARMY COLD REGIONS RESEARCH AND ENGINEERING LAB., HANOVER, NH.
UHF model simulation of detecting voids in a dielectric medium using HF-VHF airborne short-pulse radar
[AD-A231495] N91-21418
ARMY CONSTRUCTION ENGINEERING RESEARCH LAB., CHAMPAIGN, IL.
Construction site Voice Operated Information System (VOIS) test
[AD-A231633] N91-21424
ARMY ENGINEER TOPOGRAPHIC LABS., FORT BELVOIR, VA.
Design and development of the terrain information extraction system
[AD-A231166] N91-21623
Scan-line methods in spatial data systems
[AD-A231165] N91-21973
ARMY ENGINEER WATERWAYS EXPERIMENT STATION, VICKSBURG, MS.
Software development standards for project cost management information system
[AD-A231282] N91-21762
ARMY LAB. COMMAND, FORT MONMOUTH, NJ.
Quartz crystal resonators and oscillators for frequency control and timing applications: A tutorial, revision 4
[AD-A231604] N91-21445
ARMY LAB. COMMAND, WATERTOWN, MA.
Formation of controlled adiabatic shear bands in AISI 4340 high strength steel
[AD-A230999] N91-21300
ARMY NATICK LABS., MA.
Evaluation of an alternative rotorcraft cargo lowering device for the delivery of 500-lb ammunition loads
[AD-A230995] N91-21133
The effects of chemical protective gloves and glove liners on manual dexterity
[AD-A231250] N91-21721
ARMY RESEARCH INST. FOR THE BEHAVIORAL AND SOCIAL SCIENCES, ALEXANDRIA, VA.
Human performance concerns for the TRACKWOLF system
[AD-A231359] N91-21722
ARNOLD ENGINEERING DEVELOPMENT CENTER, ARNOLD AIR FORCE STATION, TN.
Evaluation of air injection in a sudden expansion diffuser for real-time afterburning application
[AD-A230850] N91-21141
Nonintrusive nitric oxide density measurements in the NASA Langley arc-heated scramjet engine test facility
[AD-A231260] N91-21142
AEDC focal plane array test capability
[AD-A230846] N91-21408
ATOMIC ENERGY COMMISSION, DAMASCUS (SYRIA).
International document on food irradiation
[DE91-615879] N91-21715

B

BALLISTIC RESEARCH LABS., ABERDEEN PROVING GROUND, MD.
Heats of explosion at low pressures, 2
[AD-A231020] N91-21328
Combustion tests of black-powder substitutes for the hand-held signal flare
[AD-A231501] N91-21330
Ab initio study of the electric dipole transition moment for the electronic X to C transition in acetylene: Theoretical predictions of the absorption and magnetic circular dichroism intensities
[AD-A231227] N91-21442
Theoretical study of the radiative lifetime for the spin-forbidden transition a3 (sigma u +) to X1 (sigma g +) in He2
[AD-A230956] N91-21854
BATTELLE COLUMBUS LABS., MOUNTAIN VIEW, CA.
Non-airborne conflicts: The causes and effects of runway transgressions
[NASA-CR-177372] N91-21121
Human factors in aviation: Terminal control area boundary conflicts
[NASA-CR-177522] N91-21714
BATTELLE INST., FRANKFURT AM MAIN (GERMANY, F.R.).
Drop evaporation in a single-axis acoustic levitator N91-21356
A new, simple electrostatic-acoustic hybrid levitator N91-21369
BATTELLE MEMORIAL INST., COLUMBUS, OH.
Variational method in the statistical theory of turbulence
[AD-A231621] N91-21484
Experiment on rapidly intensifying cyclones over the Atlantic
[AD-A231377] N91-21682
BATTELLE MEMORIAL INST., RICHLAND, WA.
Fundamental investigation of micelles and microemulsions in supercritical fluids
[AD-A231073] N91-21476
BELL COMMUNICATIONS RESEARCH, INC., PISCATAWAY, NJ.
HEAVENS system for software artifacts N91-21958
BELL TELEPHONE LABS., INC., HOLMDEL, NJ.
LDR: A submillimeter great observatory N91-22018
Submillimeter astronomy from the Antarctic plateau N91-22035
BOSTON COLL., CHESTNUT HILL, MA.
Theory of the electronic and optical properties of semiconductor heterostructures
[AD-A231438] N91-21929
Automating hypertext for decision support N91-21951
BOSTON UNIV., MA.
Photoassisted reaction of H2 with CO2 over solid catalysts
[AD-A231045] N91-21282
The effects of magnetic storm phases on F-layer irregularities from auroral to equatorial latitudes
[AD-A231373] N91-21658
BROOKHAVEN NATIONAL LAB., UPTON, NY.
Fast quasi-explicit finite difference simulation of electrochemical responses initiated by a discontinuous perturbation
[DE91-006917] N91-21271
XANES (X ray Absorption Near Edge Structure) investigation of cerium as an inhibitor for Al alloys
[DE91-005542] N91-21293
A study of the inhibition of pitting of aluminum by chromate
[DE91-006915] N91-21294
In-situ x ray measurements of pit solutions during localized corrosion
[DE91-006916] N91-21295
The use of a scanning electrochemicl impedance spectroscopy technique to investigate localized corrosion
[DE91-006918] N91-21296
Amplification of femtosecond pulses using a N2 pump laser
[DE91-008413] N91-21513
High current photoemission with 10 picosecond UV pulses
[DE91-009439] N91-21515
VM-CMS tutorial
[DE91-009444] N91-21725
Performance characteristics of Mach-Zehnder modulators for transfer of detector signals by optical fibers
[DE91-008439] N91-21873
Magnetic field induced broadening of the resistive transition in epitaxial films of YBa2Cu3O7 and Y2Ba4Cu8O16
[DE91-009825] N91-21916
BROWN UNIV., PROVIDENCE, RI.
Modified chemical vapor deposition of gradient index lenses
[AD-A230989] N91-21281
On the slowness of phase boundary motion in one space dimension
[AD-A231286] N91-21480
Radar signal categorization using a neural network N91-21782
Nucleation and growth of diamond on Si, Cu and Au substrates
[AD-A231044] N91-21918
Growth and characterization of thin films of Y2O3, La2O3 and La2CuO4
[AD-A231046] N91-21919
Preparation and characterization of Iron(III) oxide films by an novel spray pyrolysis method
[AD-A231047] N91-21920

C

CALIFORNIA INST. OF TECH., PASADENA.
Thermodynamic properties and crystallization kinetics at high liquid undercooling N91-21343
Research in nonlinear water waves
[AD-A231205] N91-21477
Dependence of the photorefractive properties of KTa(1-x)Nb(x)O3:Cu,V on Cu valence state concentration
[AD-A230954] N91-21917
A submillimeter mission for the 1990s: SMMM N91-22019
The Caltech Submillimeter Observatory N91-22032
CALIFORNIA UNIV., BERKELEY.
Photoelectron spectroscopy of Si2
[AD-A230911] N91-21853
Application of Fourier-Fresnel imaging to neutral-atom interferometry
[AD-A231154] N91-21857
The (C II) 158 micron line mapping of spiral galaxies N91-21996
Requirements for SIS receivers in the 500-1000 GHz region N91-22015
Far-infrared heterodyne technology N91-22016
Excitation of submillimeter water masers N91-22024
CALIFORNIA UNIV., BERKELEY. LAWRENCE BERKELEY LAB.
Micromechanisms of friction in electrogalvanized sheet steel with emphasis on the role of texture
[DE91-009113] N91-21290
Broad-beam, high current, metal ion implantation facility
[DE91-009329] N91-21291
Levelling of microprofiles in electrodeposition
[DE91-009083] N91-21297
Test results of a 90 MHz integrated circuit sixteen channel analog pipeline for SSC detector calorimetry
[DE91-009773] N91-21436
Design overview of a highly stable infrared free electron laser at LBL
[DE91-009327] N91-21508
Superplastic creep of eutectic tin-lead solder joints
[DE91-009074] N91-21586
Review of CERN heavy-ion physics
[DE91-009326] N91-21844

Pressure dependence of deep centers by capacitance spectroscopies inside the diamond anvil cell
[DE91-008927] N91-21906
Structural characterization of the Ag/YBa2Cu3O(7-x) interface
[DE91-009112] N91-21907
Nonlinear optical spectroscopy of Ce3(+) ions in insulating crystals
[DE91-008928] N91-21913
Promoting a healthy skepticism with regard to information processing
[DE91-007697] N91-21968

CALIFORNIA UNIV., DAVIS.
Thoughts on the chimera method of simulation of three-dimensional viscous flow N91-21063

CALIFORNIA UNIV., LOS ANGELES.
Using a microgravity environment to probe wave turbulence N91-21355
Containerless synthesis of ceramic materials using microwave heating N91-21360
Oscillational instabilities in single mode acoustics levitators N91-21376
Volcanic aerosols: Chemistry, evolution, and effects N91-21645
North Atlantic weather regimes: A synoptic study of phase space
[NASA-CR-188162] N91-21673
Nonlinear symmetric instability and oscillations in the tropical atmosphere N91-21674
Data assimilation and wind-stress error correction in a forced tropical ocean model N91-21687
Data analysis for the Pioneer-Venus electric field detector
[NASA-CR-188099] N91-22056

CALIFORNIA UNIV., SAN DIEGO.
Neural network representation and learning of mappings and their derivatives N91-21780

CALIFORNIA UNIV., SANTA BARBARA.
Tractable high performance polymers
[AD-A231072] N91-21320
Molecular beam epitaxial growth and electronic properties of GaP-on-Si (211) heterostructures, and of related systems
[AD-A231125] N91-21921

CALSPAN CORP., ARNOLD AFS, TN.
AEDC focal plane array test capability
[AD-A230846] N91-21408

CALSPAN CORP., SAN DIEGO, CA.
Constant-current stagnation-point film-anemometer probe
[AD-A231048] N91-21501

CAMBRIDGE UNIV. (ENGLAND).
The James Clerk Maxwell telescope N91-22031

CARNEGIE-MELLON UNIV., PITTSBURGH, PA.
Experimental and theoretical studies of vertical annular liquid jets
[DE91-008042] N91-21461
Using artificial intelligence to aid in the development of causal models
[AD-A231273] N91-21794
Numerical analysis and computation of nonlinear partial differential equations from applied mathematics
[AD-A231188] N91-21806

CASTING ANALYSIS CORP., WEYERS CAVE, VA.
Multiple sensor multifrequency eddy current monitor for solidification and growth N91-21362

CENTER FOR INDUSTRIAL RESEARCH, OSLO (NORWAY).
Zeolites in space N91-21165

CENTRAL RESEARCH INST. OF ELECTRIC POWER INDUSTRY, TOKYO (JAPAN).
Survey on electron beam processing technologies
[DE91-759126] N91-21866

CENTRE D'ETUDE SPATIALE DES RAYONNEMENTS, TOULOUSE (FRANCE).
Image quality of the PRONAOS telescope N91-22039

CENTRE NATIONAL D'ETUDES SPATIALES, TOULOUSE (FRANCE).
An active telescope for the sub-millimetre PRONAOS balloon-borne project N91-22038

CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE, ORSAY (FRANCE).
Submillimeter observations of interstellar dust N91-22028

CENTRO BRASILEIRO DE PESQUISAS FISICAS, RIO DE JANEIRO.
Multi-core events in cosmic-ray induced interactions with lead at around 10 TeV
[DE91-616827] N91-22062

CHICAGO UNIV., IL.
Specificity of mutation induced by ionizing radiation and oxidizing free radicals
[DE91-008838] N91-21702
Cosmic Ray Nuclei (CRN) detector investigation
[NASA-CR-184137] N91-22063

CINCINNATI UNIV., OH.
A pressure flux-split technique for computation of inlet flow behavior N91-21068
Solution of three-dimensional afterbody flow using reduced Navier-Stokes equations N91-21093
Space vehicle propulsion systems: Environmental space hazards
[NASA-CR-188094] N91-21236

CLEMSON UNIV., SC.
Analysis and design of antenna structures: Diakoptic theory and the moment method
[AD-A230838] N91-21438

CLEVELAND STATE UNIV., OH.
On the application of ENO scheme with subcell resolution to conservation laws with stiff source terms N91-21074

COLOGNE UNIV. (GERMANY, F.R.).
New Cologne acousto-optical spectrometer projects N91-22034

COLORADO SCHOOL OF MINES, GOLDEN.
Colorado School of Mines fusion gamma ray diagnostic project
[DE91-009259] N91-21889

COLORADO STATE UNIV., FORT COLLINS.
Continuation and bifurcation investigations in constrained optimization
[AD-A231639] N91-21769
Plasma contactor research, 1990
[NASA-CR-187097] N91-21880

COLORADO UNIV., BOULDER.
Center for low-gravity fluid mechanics and transport phenomena
[NASA-CR-188048] N91-21452
Analysis, preliminary design and simulation systems for control-structure interaction problems
[NASA-CR-188018] N91-21729
Implementation of a partitioned algorithm for simulation of large CSI problems
[CU-CSSC-91-4] N91-21730

COLUMBIA UNIV., NEW YORK, NY.
Analysis and interpretation of diffuse x-ray emission using data from the Einstein satellite
[NASA-CR-187988] N91-21728

COMBUSTION ELECTROMAGNETICS, INC., ARLINGTON, MA.
Spark-ignited diesel engine
[AD-A230243] N91-21533

COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION (U.S. SENATE).
NASA authorizations
[S-HRG-101-981] N91-21977
NASA overview N91-21978
NASA space shuttle/space station N91-21979
Mission to Planet Earth N91-21980
Aeronautics and space technology N91-21981
Space science and applications N91-21982
Commercial space programs N91-21983

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, ASPENDALE (AUSTRALIA).
Atmospheric methane data for the period 1986-1988 from the NOAA/CMDL global cooperative flask sampling network
[PB91-129122] N91-21626

COMPUTATIONAL MECHANICS CO., AUSTIN, TX.
Solid rocket booster internal flow analysis by highly accurate adaptive computational methods
[NASA-CR-184141] N91-21239

COMPUTER TECHNOLOGY ASSOCIATES, INC., ROCKVILLE, MD.
National plan for aviation human factors, volume 1
[PB91-100339] N91-21712
National plan for aviation human factors, volume 2
[PB91-100347] N91-21713

COOPERATIVE INST. FOR RESEARCH IN THE ATMOSPHERE, FORT COLLINS, CO.
Case study analysis of clustering applied to VAS measurements
[PB91-127829] N91-21666

CORNELL UNIV., ITHACA, NY.
The PDF method for turbulent combustion N91-21080
A plane-sweep algorithm for exact simulation of a quasi-static mechanical system of compliantly-connected rigid bodies (extended abstract)
[AD-A231324] N91-21550
Historical development of the windmill
[NASA-CR-4337] N91-21625
Fast algorithms for signal processing
[AD-A231226] N91-21759
Tools for monitoring and controlling distributed applications
[NASA-CR-188034] N91-21770
A study of rotor broadband noise mechanisms and helicopter tail rotor noise
[NASA-CR-177565] N91-21829
The effect of microstructure on the thermal conductivity of ZnS/diamond composites
[AD-A231349] N91-21928

D

DAYTON UNIV., OH.
Study of bird ingestions into small inlet area aircraft turbine engines
[DOT/FAA/CT-90/13] N91-21122

DEFENCE RESEARCH ESTABLISHMENT, OTTAWA (ONTARIO).
Definition of the concept of an interferometric spectrum analyzer for the detection of frequency hopping radios
[AD-A231031] N91-21413
Implementation of FFT and pulse compression routines on the SPT frequency domain array processor
[AD-A231320] N91-21443
Excision techniques in direct sequence spread spectrum communication systems
[AD-A231290] N91-21763

DEFENCE RESEARCH ESTABLISHMENT SUFFIELD, RALSTON (ALBERTA).
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DEUTSCHE FORSCHUNGS- UND VERSUCHSANSTALT FUER LUFT- UND RAUMFAHRT, COLOGNE (GERMANY, F.R.).
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TEMPUS: First results N91-21350

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[DLR-FB-90-41] N91-21108
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[DLR-FB-90-40] N91-21130
Results of the HHC wind tunnel tests, 1986 - 1988
[DLR-FB-90-42] N91-21152
Thermomechanics tasks and applications
[DLR-MITT-90-14] N91-21254
Flow visualization ion helicopter blades using Acenaphthen
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E

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[PB91-127720] N91-21631

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[ESDU-90036] N91-21103
Lift and rolling moment due to spoilers on wings at subsonic speeds
[ESDU-90030] N91-21129
Delamination and free edge stresses in laminated plates subjected to constant uniaxial strain (computer program)
[ESDU-90021] N91-21253
Process integration: Process change and batch processes
[ESDU-90033] N91-21390
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[ESDU-90035] N91-21537

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[ESA-TT-1198] N91-21268
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Transition and turbulence
[ESA-TT-1219] N91-21465
Angle measurements with the laser gyro GG 1342
[ESA-TT-1212] N91-21490
Structural analysis and optimization of a propfan blade by use of the finite element method
[ESA-TT-1216] N91-21566
In vitro photoreactivation of transforming DNA of Bacillus subtilis spores after irradiation by ultraviolet light
[ESA-TT-1210] N91-21699
Navigation Experiment NAVEX: Measurement and performance of the spaceborne clocks
[ESA-TT-1209] N91-21823
The indirect economic effects of the European Space Agency programs
[ESA-BR-63] N91-21975
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FIRST: Far Infrared and Submillimeter Space Telescope N91-21990
First detection of C3H2 at sub-mm wavelengths N91-22[illegible]

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Construction of flowing afterglow apparatus
[AD-A231062] N91-21855

F

FEDERAL AVIATION ADMINISTRATION, ATLANTIC CITY, NJ.
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[DOT/FAA/CT-TN90/28] N91-21238
Comparison of 14 decibels versus 20 decibels desired to undesired signal protection ratios
[DOT/FAA/CT-TN89/69] N91-21833

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[DE91-009458] N91-21655
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Diffusive transport enhancement by isolated resonances and distribution tails growth in hadronic beams
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Indirect detection of heavy supersymmetric dark matter
[DE91-009669] N91-22055

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The software system on parallel processor for computational fluid dynamics N91-21388

G

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Modeling of rolling element bearing mechanics
[NASA-CR-188045] N91-21530

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Embedded computers: Navy's approach to developing patrol aircraft avionics system too risky
[AD-A230868] N91-21136
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[AD-A230864] N91-21820

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Statistical fluctuations in lasers
[DE91-009540] N91-21517
Acquisition and production of skilled behavior in dynamic decision-making tasks
[NASA-CR-188084] N91-21939
Laboratory evaluation and application of microwave absorption properties under simulated conditions for planetary atmospheres
[NASA-CR-188096] N91-22057

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[DE91-619859] N91-21909

H

HARRY DIAMOND LABS., ADELPHI, MD.
The fast Hartley transform
[AD-A230370] N91-21400
Image recovery by simulated annealing
[AD-A230655] N91-21869
Host materials for 4d(sup N) and 5d(sup N) transition-metal ions
[AD-A231606] N91-21933

HARVARD-SMITHSONIAN CENTER FOR ASTROPHYSICS, CAMBRIDGE, MA.
The Smithsonian Astrophysical Observatory submillimeter wave telescope array N91-22009
Submillimeter water masers at 321 and 325 GHz N91-22023

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Report of the panel on earth structure and dynamics, section 6 N91-21595
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[AD-A231135] N91-21693

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HONEYWELL, INC., BLOOMINGTON, MN.
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[NASA-CR-188089] N91-21403
An endorsement-based approach to student modeling for planner-controlled intelligent tutoring systems
[NASA-CR-188177] N91-21739
Experience with abstract notation one
[NASA-CR-188090] N91-21741
Designing a training tool for imaging mental models
[NASA-CR-187891] N91-21776
Documentation for the token ring network simulation system
[NASA-CR-188093] N91-21789
Analysis of exhaustive limited service for token ring networks
[NASA-CR-188092] N91-21790
Queueing models for token and slotted ring networks
[NASA-CR-188091] N91-21791
SEPEC conference proceedings: Hypermedia and Infromation Reconstruction. Aerospace applications and research directions
[NASA-CR-187935] N91-21940
A model for addressing navigation limitations and metacognitive constraints in hypermedia training systems N91-21945

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[NASA-CR-187936] N91-21955
XTP for the NASA space station
[NASA-CR-188087] N91-21966

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I

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[NASA-CR-188148] N91-21492
Theoretical studies in elementary particle physics
[DE91-009543] N91-21851

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Strength of polymer interfaces
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[AD-A231249] N91-21793

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Practical methods to evaluate the friction drag coefficient of a projectile in free flight
[ISL-R-123/89] N91-21105
Comparison study of the aerodynamic coefficients measured on models with circular or squared section and large elongation in supersonic flow
[ISL-R-125/89] N91-21106
Deep overheating of thin bodies in flight with very low-angled trajectory
[ISL-R-126/89] N91-21107
Possibilities of trajectory modification
[ISL-CO-209/90] N91-21151
Considerations and studies for the construction of acceleration coils for inductive launchers
[ISL-CO-240/89] N91-21173
Advantage of nonguided hypervelocity projectiles in antimissile warfare
[ISL-R-110/90] N91-21174
Study of the absorption lines widened by the effect of pressure, emitted by the combustion gases of propulsive powders
[ISL-R-124/89] N91-21237
Automatic program correction of interferometry quadratic sensor errors. Application to the processing of signals from a VISAR interferometer
[ISL-R-127/89] N91-21799
Propagation of helicopter noise in the low atmosphere layers
[ISL-CO-203/90] N91-21830
Calculation of thickness and charge noise radiated by a rotor in forward flight
[ISL-R-119/89] N91-21831
Blade-wake interaction on a two blade rotor with prediction of the radiated noise stationary and forward flight, comparison between calculation, and experiment
[ISL-R-120/89] N91-21832

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[NASA-CR-187538] N91-21099
Preliminary calibration of a generic scramjet combustor
[NASA-CR-187539] N91-21139
Turbulent separated flow past a backward-facing step: A critical evaluation of two-equation turbulence models
[NASA-CR-187532] N91-21451
Probability distribution functions in turbulent convection
[NASA-CR-187519] N91-21453
Predicting chaos for infinite dimensional dynamical systems: The Kuramoto-Sivashinsky equation, a case study
[NASA-CR-187531] N91-21454
Singularities in water waves and Rayleigh-Taylor instability
[NASA-CR-187530] N91-21455
Uniform high order spectral methods for one and two dimensional Euler equations
[NASA-CR-187535] N91-21456
Domain decomposition methods in computational fluid dynamics
[NASA-CR-187529] N91-21457
Performance effects of irregular communications patterns on massively parallel multiprocessors
[NASA-CR-187514] N91-21724
A fully Galerkin method for the recovery of stiffness and damping parameters in Euler-Bernoulli beam models
[NASA-CR-187517] N91-21796
Numerical recovery of certain discontinuous electrical conductivities
[NASA-CR-187543] N91-21800
On one-sided filters for spectral Fourier approximations of discontinuous functions
[NASA-CR-187541] N91-21801

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[DE91-619585] N91-21798
Strange particles production and absorption in nuclei at high energies
[DE91-620399] N91-21845
Characteristic x rays method for detecting cold fusion
[DE91-619982] N91-21890
Physics without physical constants
[DE91-619576] N91-21935

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AVHRR/NOAA imagery navigation from the geodetic reference matrix: Studies and evaluations
[INPE-5216-PRE/1672] N91-21126
OD system for the first Brazilian satellite-software testing, analysis, and assessment
[INPE-5158-PRE/1637] N91-21169
Real time assisted tracking for low Earth orbit satellites
[INPE-5157-PRE/1636] N91-21170
A stochastic approach to the problem of spacecraft optimal manoeuvres
[INPE-5192-PRE/1660] N91-21171
Determination of pitch and roll angles with respect to a point on earth surface
[INPE-5206-PRE/1668] N91-21215
Proposed methodology for the study of urban environment and space structure in metropolitan area
[INPE-5203-PRE/1665] N91-21216
Materials for aerospace vehicles friction drag reduction surfaces
[INPE-5188-PRE/1656] N91-21217
Attitude control simulation of the data collecting satellite: SCD2
[INPE-5159-PRE/1638] N91-21218
Requirements and trade-off studies in satellite mechanical architecture
[INPE-5186-PRE/1654] N91-21219
Comparative study of VLF signals in the sub-Antarctic region
[INPE-5165-TDL/426] N91-21406
Study of asymmetrical electric discharges using particle simulation
[INPE-5198-TDL/427] N91-21432
Evaluation of TM/LANDSAT-5 bands in the discrimination of wheat and beam crops
[INPE-5204-PRE/1666] N91-21602
Remote sensing estimation of total chlorophyll pigment distribution in Barra Bonita Reservoir
[INPE-5202-PRE/1664] N91-21603
TM/LANDSAT-5 multispectral reflectance for the remote sensing of the condition of bean crop vigor
[INPE-5184-PRE/1652] N91-21604
Experiences in assessing changes in the use of savanna ecosystems
[INPE-5187-PRE/1655] N91-21605
Verification of parameters and morphological-environmental properties, by satellite imagery, for studies of coastal region planning
[INPE-5177-PRE/1646] N91-21606
Temporal variation of areas occupied by aquatic macrophytes in the Tucurui reservoir through Landsat/TM data
[INPE-5174-PRE/1643] N91-21607
Spot 1: Imagery in geologic mapping: A comparative study with several remote sensing products in the Curaca River Valley, Bahia
[INPE-5136-PRE/1624] N91-21608
Use of direct expansion for estimation of soybean and corn areas through multispectral and temporal LANDSAT/TM data
[INPE-5180-PRE/1649] N91-21609
Volcanic-sedimentary sequence of the Greenstone Belt type in the Santa Rita or Goias elevation: An approach with TM-Landsat data
[INPE-5178-PRE/1647] N91-21610
Comparative analysis of AVHRR/NOAA and TM/LANDSAT data in the delimitation of savanna/forest contact area: Preliminary results
[INPE-5200-RPE/639] N91-21611
Introduction to digital imagery processing
[INPE-5212-MD/46] N91-21612
Discrimination of lithological units in the lower Valley of the Curaca River (Bahia), through enhancement of digital processing of MSS-LANDSAT-3 data
[INPE-5120-RPE/627] N91-21613
Spectral responses of soybean and cotton from Landsat/TM digital data
[INPE-5179-PRE/1648] N91-21614
Production of image proportions through a linear mixing model
[INPE-5170-PRE/1639] N91-21615
Data integration of different sensor systems through the technique of IHS transformation, the purpose and study of intra-urban structure
[INPE-5171-PRE/1640] N91-21616
A digital data bank for geological exploration in the mining belt of the Pojuca (Carajas) Cu-Zn deposit, based on geological, geochemical, remote sensing, and elevation data
[INPE-5172-PRE/1641] N91-21617
Correlative studies between spectral responses and weathering indices of alternate weathered cover
[INPE-5176-PRE/1645] N91-21618
Spectral characteristics of agricultural crops and yield
[INPE-5125-RPE/630] N91-21619
Characterization of antropic action in the Mearim (MA) middle-low valley through LANDSAT/TM imagery
[INPE-5075-PRE/1594] N91-21620
Evaluation of indigenous areas utilizing TM/LANDSAT data
[INPE-5173-PRE/1642] N91-21636
Audiomagnetotelluric (AMT) soundings in the proximity of the Camaqua (RS) mines
[INPE-5213-RPE/641] N91-21651
Variability of the Sq focus position in the South American continent
[INPE-4740-PRE/1415] N91-21652
Statistical forecasting of precipitation associated with the passage of frontal systems in the south region of Brazil
[INPE-5208-TDL/429] N91-21672
IDEAL, a dialogic interface in a natural language for expert systems
[INPE-5151-TDL/424] N91-21742
Implementation of a matrix theorem prover for propositional modal logic
[INPE-5124-RPE/629] N91-21743
Implementation in two classes of C (++) for morphological processing of images
[INPE-5217-RPE/642] N91-21744

A monotone decreasing algorithm for the 0-1 multiknapsack dual problem
[INPE-5160-RPE/635] N91-21745
Identification of parameters derived from inertial sensors
[INPE-5166-RPE/637] N91-21746
Utilization of GPIOP in the matrix processor FPS-5410
[INPE-5152-RPE/634] N91-21747
Numerical analysis methods. Volume 3: Autocorrection methods
[INPE-5196-MD/45] N91-21807
Nuclear radiation detectors
[INPE-5090-MD/44] N91-21847
Design and construction of a formed pulse circuit for a plasma centrifuge
[INPE-5161-RPE/639] N91-21895
Experimental study project of plasma waves and turbulences
[INPE-5127-RPE/632] N91-21896
Identification of information needs in a research institute
[INPE-5154-TDL/425] N91-21967
NGC3309: An S-shaped radio galaxy in a nearby cluster
[INPE-5143-PRE/1631] N91-22054
Spectral analysis of annual sunspot series: An update
[INPE-5207-PRE/1669] N91-22060
An unusual case of meter wave type-3 bursts leading millimeter-wave bursts
[INPE-5140-PRE/1628] N91-22064

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[AD-A231339] N91-21322
Finding a single molecule in a haystack: Laser spectroscopy of solids from square root of (N to N) = 1
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[AD-A231338] N91-21926

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NCTM of liquids at high temperatures using polarization techniques N91-21345
Optical property measurements as a diagnostic tool for control of materials processing in space and on Earth N91-21366
Containerless processing of amorphous ceramics N91-21367
Some considerations for various positioning systems and their science capabilities N91-21372

IOWA UNIV., IOWA CITY.
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[AD-A231315] N91-21549

ISHIKAWAJIMA-HARIMA HEAVY INDUSTRIES CO. LTD., TOKYO (JAPAN).
Present and future of CFD on the aero-engine development in IHI N91-21381

J

JACKSON STATE UNIV., MS.
Geographic information systems: A primer
[AD-A231465] N91-21974

JET PROPULSION LAB., CALIFORNIA INST. OF TECH., PASADENA.
Spray combustion modeling and evaluation
[DE91-007923] N91-21264
Proceedings of the First Workshop on Containerless Experimentation in Microgravity
[NASA-CR-187806] N91-21331
Ground-based and microgravity containerless positioning technologies and facilities N91-21333
Containerless experiments in fluid physics in microgravity N91-21341
Containerless protein crystal growth technology: Electrostatic multidrop positioner N91-21352
Undercooling of acoustically levitated molten drops N91-21359
High temperature acoustic and hybrid microwave/acoustic levitators for materials processing N91-21368
Feedback controlled electrostatic and electromagnetic sample positioners N91-21370
A computer model of the electrostatic positioning system N91-21371
Laterally stacked Schottky diodes for infrared sensor applications
[NASA-CASE-NPO-17426-1-CU] N91-21434
Method and apparatus for configuration control of redundant robots
[NASA-CASE-NPO-17801-1-CU] N91-21544
Report of the panel on earth rotation and reference frames, section 7 N91-21596
System and method for measuring ocean surface currents at locations remote from land masses using synthetic aperture radar
[NASA-CASE-NPO-17937-1-CU] N91-21621
Integrating knowledge and control into hypermedia-based training environments: Experiments with HyperCLIPS N91-21949
The confusion limits to the sensitivity of submillimeter telescopes N91-22001
Submillimeter astronomy and low mass star formation N91-22012
Development of components for submillimeter wave heterodyne radiometers at JPL N91-22017
Telescope technology for space-borne submillimeter astronomy N91-22049

JOHNS HOPKINS UNIV., BALTIMORE, MD.
The overall response of composite materials undergoing large elastic deformations
[AD-A231637] N91-21260

JOINT EUROPEAN TORUS PROJECT, ABINGDON (ENGLAND).
Sawteeth and their stabilization in JET
[DE91-005459] N91-21882
High performance H modes in JET
[DE91-005488] N91-21883
Comparison of beryllium and graphite first-walls in JET
[DE91-005489] N91-21884
High density regimes and beta limits in JET
[DE91-005490] N91-21885
ICRF heating in reactor grade plasmas
[DE91-005491] N91-21886
Recent JET results and future prospects
[DE91-005474] N91-21897

JOINT OCEANOGRAPHIC INST., INC., WASHINGTON, DC.
Polar research from satellites
[NASA-CR-188025] N91-21640

K

KAWASAKI HEAVY INDUSTRIES LTD., GIFU (JAPAN).
CFD research and systems in Kawasaki Heavy Industries and its future prospects N91-21382

KENT UNIV., CANTERBURY (ENGLAND).
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KRUG INTERNATIONAL, SAN ANTONIO, TX.
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[AD-A231355] N91-21710

L

LA SAPIENZA UNIV., ROME (ITALY).
Computational modelling of dump combustors flowfield N91-21096

LANCASTER UNIV. (ENGLAND).
The importance of submillimetre observations of radio quiet and radio loud AGN's N91-22000

LASER APPLICATIONS RESEARCH CENTER, THE WOODLANDS, TX.
Thermophysical property measurements in electromagnetic levitators N91-21344

LAWRENCE LIVERMORE NATIONAL LAB., CA.
Simulation of chemical kinetics in combustion
[DE91-008446] N91-21273
Scanning tunneling microscopy of reactive sites: Gasification of graphite by oxygen and hydrogen
[DE91-008569] N91-21274
Potentiometric titration of gold, platinum, and some other precious metals
[DE91-008989] N91-21276
Organic aerogels: A new type of ultrastructured polymer
[DE91-008500] N91-21312
The single antenna interferometer
[DE91-007128] N91-21407
X ray laser holography of biological microstructures
[DE91-008732] N91-21488
Stress-strain gage measurements on a Nevada Test Site (NTS) event using pairs of triple foil gages
[DE91-005061] N91-21497
Preliminary field demonstration of a fiber-optic TCE sensor
[DE91-008453] N91-21498
Modeling the absorption of intense, short laser pulses in steep density gradients
[DE91-008735] N91-21503
Toward high brightness, multi-kilowatt solid state lasers
[DE91-008990] N91-21504
The theory of temporal compression of intense pulses in a metal vapor
[DE91-005059] N91-21509
Laser pulse compression in strontium and calcium vapor
[DE91-007346] N91-21511
The Basis version of LASNEX
[DE91-009483] N91-21516
Laser test for spindle parallelism
[DE91-009716] N91-21518
Nondestructive imaging of materials microstructure using x ray tomographic microscopy
[DE91-008505] N91-21554
PALM2D: A nonlinear finite element program for the coupled thermomechanical response of solids in two dimensions
[DE91-008423] N91-21584
User's manual for SLAB: An atmospheric dispersion model for denser-than-air-releases
[DE91-008443] N91-21638
Quasilinear simulation of auroral kilometric radiation by a relativistic Fokker-Planck code
[DE91-009736] N91-21656
Recent developments in Monte Carlo techniques
[DE91-009750] N91-21808
Effectiveness of bomber deployed autonomous airborne vehicles in finding rail mobile SS-24s
[DE91-009008] N91-21815
Some observations concerning alpha instabilities and driven tokamak reactors
[DE91-008628] N91-21898
Characterization of the plasma-switch interaction in the LBL HIF ion source
[DE91-009479] N91-21902
The streamlined Darwin field method (and a solution technique that makes it practical)
[DE91-009482] N91-21903
Interplay between local environment effect and electronic structure properties in close packed structures
[DE91-008506] N91-21915

LEHIGH UNIV., BETHLEHEM, PA.
High octane ethers from synthesis gas-derived alcohol
[DE91-008367] N91-21325
Real-time measurement of materials properties at high temperatures by laser produced plasmas N91-21342

LEIDEN UNIV. (NETHERLANDS).
The 0 deg (63 micron) line emission from galactic high latitude cirrus clouds N91-22029

LOCKHEED ENGINEERING AND SCIENCES CO., HOUSTON, TX.
Kapton wire arc track testing: Per test procedure KWATT BB01
[NASA-CR-185642] N91-21427

LOGICON, INC., DAYTON, OH.
A field evaluation of the compatibility of the protective integrated hood mask with ANVIS night vision goggles
[AD-A230237] N91-21718

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[AD-A229956] N91-21716

LONDON UNIV. (ENGLAND).
Performance tests on Ge:Ga and Ge:Be detectors for the ISO long wavelength spectrometer N91-22045

LOS ALAMOS NATIONAL LAB., NM.
Notes on space, satellites, and survivability
[DE91-009229] N91-21226
High-performance capillary electrophoresis of histones
[DE91-008585] N91-21275
Deformation substructures induced by high-rate deformation
[DE91-008595] N91-21288
Layer tracking asymptotics and domain decomposition
[DE91-008593] N91-21462

Computer animation of NASTRAN displacements on IRIS 4D-series workstations: CANDI/ANIMATE postprocessing of NASHUA results
[DE91-008605] N91-21585
Requirements for progressive strategic defenses
[DE91-008997] N91-21812
Near-term boost-phase defense sensitivities
[DE91-008999] N91-21813
Interaction of strategic defenses with crisis stability
[DE91-009002] N91-21814
Strategic defense requirements for progressive applications
[DE91-009045] N91-21816
Threat modernization in the near term
[DE91-009228] N91-21817
Discrimination options in the near term
[DE91-009000] N91-21818
Background issues for defensive interceptors
[DE91-009219] N91-21819
Radiation dose calculations with the Monte Carlo method
[DE91-008582] N91-21841
Superconducting Super Collider silicon tracking subsystem research and development
[DE91-009227] N91-21862
Advanced, time-resolved imaging techniques for electron-beam characterizations
[DE91-008587] N91-21865

LOUISIANA STATE UNIV., BATON ROUGE.
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[AD-A231340] N91-21329

LUND INST. OF TECH. (SWEDEN).
Sampling and characterization of aerosols
[LUNDD/TMAT-90/2002] N91-21269

M

MADISON MAGNETICS, INC., WI.
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Large gap magnetic suspension system N91-21201

MANCHESTER UNIV. (ENGLAND).
Interstellar chemistry and submillimetre astronomy N91-22021

MARYLAND UNIV., COLLEGE PARK.
Modeling failure and reliability in new-generation devices
[AD-A230998] N91-21439
Volcanic effects on climate N91-21646
Time-resolved extreme-ultraviolet spectroscopy of laser-produced plasmas originating at the parylene layer of microballon targets
[DE91-009378] N91-21900

MASSACHUSETTS INST. OF TECH., CAMBRIDGE.
Generation and use of unstructured grids for turbomachinery calculations N91-21064
Computational study of three dimensional viscous flow through a turbine cascade using a multi-domain spectral technique N91-21066
A time delay controller for magnetic bearings N91-21205
Control of catalytic hydrotreating selectivity with ammonia
[DE91-008405] N91-21272
Artifact diamond characterization
[AD-A231555] N91-21323
A criterion for the optimal design of multi-axis force sensors
[AD-A231014] N91-21500
Feature matching for object localization in the presence of uncertainty
[AD-A231405] N91-21766
An efficient correspondence based algorithm for 2D and 3D model based recognition
[AD-A231406] N91-21767
On the massively parallel solution of the assignment problem
[AD-A230847] N91-21775
The study of plasma clouds around large active space structures
[AD-A230634] N91-21881
Grain boundaries
[DE91-007932] N91-21905

MASSACHUSETTS INST. OF TECH., LEXINGTON.
Estimating power amplifier large signal gain
[AD-A230823] N91-21437

MASSACHUSETTS UNIV., AMHERST.
Synthesis, structure, and properties of segmented polyurethanes
[AD-A230966] N91-21319

MATSUSHITA ELECTRIC INDUSTRIAL CO. LTD., MORIGUCHI (JAPAN).
Learning control of inverted pendulum system by neural network driven fuzzy reasoning: The learning function of NN-driven fuzzy reasoning under changes of reasoning environment N91-21785

MAX-PLANCK-INST. FUER PHYSIK UND ASTROPHYSIK, GARCHING (GERMANY, F.R.).
The galactic center at submillimeter and far-infrared wavelengths N91-22002
The MPE/UCB Far-Infrared imaging Fabry-Perot Interferometer (FIFI) N91-22005
Coherent and incoherent detection N91-22010

MAX-PLANCK-INST. FUER RADIOASTRONOMIE, BONN (GERMANY, F.R.).
The 1.3 mm continuum emission from circumstellar envelopes N91-22007
Investigation of highly excited CO transitions in OMC-1 N91-22013
A highly collimated bipolar outflow in the core of OMC-1: CO submillimeter emission N91-22014
Sub-mm direct photometry with large telescopes N91-22027
The search for protostars in high mass star forming regions N91-22030
The Submillimeter Telescope (SMT) N91-22033
Airborne heterodyne receiver for the range 600 GHz to 3,000 GHz N91-22047

MBC APPLIED ENVIRONMENTAL SCIENCES, INC., COSTA MESA, CA.
Third Information Transfer Meeting
[PB91-123922] N91-21961

MECHANICAL TECHNOLOGY, INC., LATHAM, NY.
Reduction in bearing size due to superconductors in magnetic bearings N91-21211

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Instructional Support System (ISS). Beginner's manual (Zenith 248 version only)
[PB91-127332] N91-21734

MELBOURNE UNIV., PARKVILLE (AUSTRALIA).
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[DE91-621717] N91-21846

MICHIGAN STATE UNIV., EAST LANSING.
First principles theory of the interaction of hydrogen with surfaces and bulk of transition metals
[AD-A231248] N91-21285

MICHIGAN UNIV., ANN ARBOR.
Flux-vector splitting for the 1990s N91-21073

MICRO ELECTRONICS A.S. SPACE, HORTEN (NORWAY).
Application of SAW technology in satellites for mobile services N91-21163

MICROELECTRONICS AND COMPUTER TECHNOLOGY CORP., AUSTIN, TX.
AiGERM: A logic programming front end for GERM N91-21957

MINNESOTA UNIV., MINNEAPOLIS.
Eigenspace design of helicopter flight control systems
[AD-A231588] N91-21153
Field intercomparison of precipitation samplers for assessing wet deposition of organic contaminants
[PB91-125880] N91-21629

MISSOURI UNIV., COLUMBIA.
Engineering specification and system design for CAD/CAM of custom shoes: UMC project effort
[NASA-CR-188049] N91-21733
Experiments on neural network architectures for fuzzy logic N91-21787

MITRE CORP., BEDFORD, MA.
Noise factor and antenna gains in the signal/noise equation for over-the-horizon radar
[AD-A231203] N91-21416

MITSUBISHI HEAVY-INDUSTRIES LTD., NAGOYA (JAPAN).
Status and outlook of CFD technology at Mitsubishi Heavy Industries, Nagoya N91-21384

MMR TECHNOLOGIES, INC., MOUNTAIN VIEW, CA.
Development of a low noise 10 KJ-T refrigeration system
[AD-A231383] N91-21392
Development of a low noise 10K J-T refrigeration system
[AD-A231461] N91-21393

MOSCOW STATE UNIV. (USSR).
On the temperature corrections for QED operators in the superstrong magnetic field
[DE91-619627] N91-21822
Hamilton mechanics for nonlocal systems
[DE91-619625] N91-21936
Quantization of nonlocal theories and gravitation
[DE91-619626] N91-21937

MOUND LAB., MIAMISBURG, OH.
Post-encapsulation plutonia reduction for Galileo and Ulysses GPHS modules: The Module Reduction and Monitoring Facility (MRMF)
[DE91-008131] N91-21861

N

NATIONAAL INST. VOOR KERNFYSICA EN HOGE ENERGIEFYSICA, AMSTERDAM (NETHERLANDS).
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[DIGEL-1990-5] N91-21431
Grid pulse generator
[DIGEL-1990-6] N91-21863

NATIONAL ACADEMY OF SCIENCES - NATIONAL RESEARCH COUNCIL, WASHINGTON, DC.
Science, medicine and animals
[ISBN-0-309-04439-1] N91-21697

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, WASHINGTON, DC.
Charge of the containerless experimentation in microgravity N91-21332
Solid earth science in the 1990s. Volume 2: Panel reports
[NASA-TM-4256-VOL-2] N91-21590
Report of the panel on geopotential fields: Gravity field, section 8 N91-21597
Report of the panel on international programs N91-21599
Exploring the living universe: A strategy for space life sciences
[NASA-TM-103399] N91-21696
Radiation health research, 1986 - 1990
[NASA-TM-4270] N91-21704
The 1991/92 graduate student researchers program, including the underrepresented minority focus component
[NASA-TM-101801] N91-22065

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. AMES RESEARCH CENTER, MOFFETT FIELD, CA.
Simulation of nap-of-the-Earth flight in helicopters
[NASA-TM-102830] N91-21131
Suppression of biodynamic interference in head-tracked teleoperation
[NASA-TM-103833] N91-21134
Digital signal conditioning for flight test instrumentation
[NASA-TM-101739] N91-21135
Characteristic eddy decomposition of turbulence in a channel
[NASA-TM-100065] N91-21470
Estimates of thermochemical relaxation lengths behind normal shock waves relevant to manned lunar and Mars return missions, the aeroassist flight experiment, and Mars entry
[NASA-TM-102879] N91-21471
Acoustic and aerodynamic study of a pusher-propeller aircraft model
[NASA-TP-3040] N91-21828
SOFIA: The Stratospheric Observatory For Infrared Astronomy N91-22003
The submillimeter wave astronomy satellite N91-22025
NASA Ames aerospace systems directorate research
[NASA-TM-103844] N91-22066

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. GODDARD SPACE FLIGHT CENTER, GREENBELT, MD.
AEOSS design guide for system analysis on Advanced Earth-Orbital Spacecraft Systems
[NASA-TM-100772] N91-21223
AEOSS runtime manual for system analysis on Advanced Earth-Orbital Spacecraft Systems
[NASA-TM-100773] N91-21224
Redistribution of particulates on a payload during flight ascent
[NASA-TM-104539] N91-21255
Connection space reduction mechanism
[NASA-CASE-GSC-13220-1] N91-21525
Report of the panel on plate motion and deformation, section 2 N91-21591
Report of the panel on geopotential fields: Magnetic field, section 9 N91-21598
Volcanism-Climate Interactions
[NASA-CP-10062] N91-21641
Historical evidence for a connection between volcanic eruptions and climate change N91-21642
Climatic impact of volcanic eruptions N91-21643
Geodynamics branch data base for main magnetic field analysis
[NASA-TM-104542] N91-21653

Geomagnetic model investigations for 1980 - 1989: A model for strategic defense initiative particle beam experiments and a study in the effects of data types and observatory bias solutions
[NASA-TM-104541] N91-21654

GEMPAK5 user's guide, version 5.0
[NASA-TM-4260] N91-21661

GEMPAK5. Part 1: GEMPAK5 programmer's guide, version 5.0
[NASA-TM-4261-PT-1] N91-21662

GEMPAK5. Part 2: GEMPLT programmer's guide, version 5.0
[NASA-TM-4261-PT-2] N91-21663

Hypermedia and intelligent tutoring applications in a mission operations environment N91-21948

Early results from the Cosmic Background Explorer (COBE) N91-21988

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. HUGH L. DRYDEN FLIGHT RESEARCH FACILITY, EDWARDS, CA.

A preliminary evaluation of an F100 engine parameter estimation process using flight data
[NASA-TM-4216] N91-21446

STARS: An integrated general-purpose finite element structural, aeroelastic, and aeroservoelastic analysis computer program
[NASA-TM-101709-REV] N91-21587

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Dynamics of vegetation and soils of oak/saw palmetto scrub after fire: Observations from permanent transects
[NASA-TM-103817] N91-21635

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. LYNDON B. JOHNSON SPACE CENTER, HOUSTON, TX.

High-pressure promoted combustion chamber
[NASA-CASE-MSC-21470-1] N91-21157

Parametric entry corridors for lunar/Mars aerocapture missions
[NASA-TM-102178] N91-21168

Overcenter collet space station truss fastener
[NASA-CASE-MSC-21504-1] N91-21221

Orbital debris sweeper and method
[NASA-CASE-MSC-21534-1] N91-21222

Atomic oxygen degradation of Intelsat 4-type solar array interconnects: Laboratory investigations
[NASA-TM-102175] N91-21286

Volumetric measurement of tank volume
[NASA-CASE-MSC-21500-1] N91-21493

Flexible diaphragm-extreme temperature usage
[NASA-CASE-MSC-20797-2] N91-21494

Tank gauging apparatus and method
[NASA-CASE-MSC-21059-3] N91-21495

Method and apparatus for positioning a robotic end effector
[NASA-CASE-MSC-21476-1] N91-21542

Alignment positioning mechanism
[NASA-CASE-MSC-21502-1] N91-21543

Report of the panel on volcanology, section 4 N91-21593

Rotating bio-reactor cell culture apparatus
[NASA-CASE-MSC-21293-1] N91-21700

Spiral vane bioreactor
[NASA-CASE-MSC-21361-1] N91-21701

Proceedings of the Second Joint Technology Workshop on Neural Networks and Fuzzy Logic, volume 1
[NASA-CP-10061-VOL-1] N91-21778

Experiment Document Information System (EDIS) evolution N91-21941

Life sciences on-line: A study in hypermedia application N91-21943

GERM as a tool for space station documentation N91-21950

A knowledge base browser using hypermedia N91-21956

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. LANGLEY RESEARCH CENTER, HAMPTON, VA.

Static thrust-vectoring performance of nonaxisymmetric convergent-divergent nozzles with post-exit yaw vanes
[NASA-TP-3085] N91-21059

Computation of laminar viscous-inviscid interactions in high-speed internal flows N91-21087

Two and three-dimensional shock-shock interactions on the blunt leading edges of the hypersonic inlets N91-21088

The direct simulation of high-speed mixing-layers without and with chemical heat release N91-21095

Numerical simulation of transverse fuel injection N91-21097

A highly efficient engineering tool for three-dimensional scramjet flowfield and heat transfer computations N91-21098

Span reduction effects on the flutter characteristics of arrow-wing supersonic transport configurations
[NASA-TP-3077] N91-21127

A simple, analytical, axisymmetric microburst model for downdraft estimation
[NASA-TM-104053] N91-21132

Hot-bench simulation of the active flexible wing wind-tunnel model
[NASA-TM-102758] N91-21144

Torsional suspension system for testing space structures
[NASA-CASE-LAR-14149-1-SB] N91-21176

Dynamic response of a hammerhead launch vehicle wind-tunnel model
[NASA-TM-104050] N91-21177

Aerobrake assembly with minimum Space Station accommodation
[NASA-TM-102778] N91-21183

The spacecraft control laboratory experiment optical attitude measurement system
[NASA-TM-102624] N91-21186

Aerospace Applications of Magnetic Suspension Technology, part 1
[NASA-CP-10066-PT-1] N91-21188

Propulsion simulator for magnetically-suspended wind tunnel models N91-21198

A solid-state controllable power supply for a magnetic suspension wind tunnel N91-21199

Description of the Large-Gap Magnetic Suspension System (LGMSS) ground based experiment N91-21200

Stability considerations for magnetic suspension systems using electromagnets mounted in a planar array N91-21202

Aerospace Applications of Magnetic Suspension Technology, part 2
[NASA-CP-10066-PT-2] N91-21203

Chemical spray pyrolysis of Tl-Ba-Ca-Cu-O high-T(sub c) superconductors for high-field bitter magnets N91-21212

Pre-integrated structures for Space Station Freedom
[NASA-TM-102780] N91-21214

Dynamic and control assessment of the Space Station Freedom payload pointing system
[NASA-TM-101667] N91-21225

Catalyst for carbon monoxide oxidation
[NASA-CASE-LAR-14155-2-SB] N91-21270

Synthesis of imide/arylene ether copolymers for adhesives and composite matrices
[NASA-TM-104067] N91-21306

Imide/arylene ether block copolymers
[NASA-TM-104066] N91-21308

Radiographic instrumentation for DPM experiments N91-21373

Phase-lock-loop application for fiber optic receiver
[NASA-TM-102776] N91-21435

Method and apparatus for detecting laminar flow separation and reattachment
[NASA-CASE-LAR-13952-2-SB] N91-21472

Heat tube device
[NASA-CASE-KSC-11395-1-CU] N91-21473

Single element magnetic suspension actuator
[NASA-CASE-LAR-13981-1] N91-21539

Mechanical strain isolator mount
[NASA-CASE-LAR-13580-1] N91-21541

Determination of the flight hardware configuration of an energy absorbing attenuator for the proposed Space Station crew and equipment translation aid cart
[NASA-TP-3084] N91-21556

Closed-form solutions for linear regulator design of mechanical systems including optimal weighting matrix selection
[NASA-TM-104052] N91-21572

Passive dynamic controllers for nonlinear mechanical systems
[NASA-TM-104047] N91-21573

Comparison of several system identification methods for flexible structures
[NASA-TM-104046] N91-21574

Identification of linear multivariable systems from a single set of data by identification of observers with assigned real eigenvalues
[NASA-TM-102669] N91-21575

A discourse on sensitivity analysis for discretely-modeled structures
[NASA-TM-104065] N91-21577

Active vibration absorber for CSI evolutionary model: Design and experimental results
[NASA-TM-104048] N91-21578

On-orbit damage detection and health monitoring of large space trusses: Status and critical issues
[NASA-TM-104045] N91-21579

Stacking-sequence optimization for buckling of laminated plates by integer programming
[NASA-TM-104033] N91-21580

Second-order discrete Kalman filtering equations for control-structure interaction simulations
[CU-CSSC-91-5] N91-21731

Parallel computations and control of adaptive structures N91-21732

A multiblock multigrid three-dimensional Euler equation solver
[NASA-TM-103424] N91-21795

Permanent magnet flux-biased magnetic actuator with flux feedback
[NASA-CASE-LAR-13785-1] N91-21824

The sound of moving bodies
[NASA-TM-103342] N91-21827

Frequency response calibration of recess-mounted pressure transducers
[NASA-TM-104031] N91-21834

Corrections to the participant-spectator model of high-energy alpha-particle fragmentation
[NASA-TM-4262] N91-21860

Enhanced single layer multi-color or luminescent display with coactivators
[NASA-CASE-LAR-14181-1] N91-21911

NASA/DoD aerospace knowledge diffusion research project. Paper 9: Information intermediaries and the transfer of aerospace Scientific and Technical Information (STI). A report from the field
[NASA-TM-103384] N91-21959

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. LEWIS RESEARCH CENTER, CLEVELAND, OH.

Compressible flows with periodic vortical disturbances around lifting airfoils
[NASA-TM-103742] N91-21060

Experimental study of boundary layer transition on a heated flat plate
[NASA-TM-103779] N91-21061

Computational Fluid Dynamics Symposium on Aeropropulsion
[NASA-CP-3078] N91-21062

A finite-difference, frequency-domain numerical scheme for the solution of the linearized unsteady Euler equations N91-21067

Simulation of turbomachinery flows N91-21069

Transonic cascade flow calculations using non-periodic C-type grids N91-21071

Implicit solution of three-dimensional internal turbulent flows N91-21082

Numerical investigation of an internal layer in turbulent flow over a curved hill N91-21083

Heat transfer, velocity-temperature correlation, and turbulent shear stress from Navier-Stokes computations of shock wave/turbulent boundary layer interaction flows N91-21085

Dynamics of local grid manipulations for internal flow problems N91-21090

The 3D computation of single-expansion-ramp and scramjet nozzles N91-21092

An experimental comparison of nonswirling and swirling flow in a circular-to-rectangular transition duct
[NASA-TM-104359] N91-21115

Hot gas ingestion test results of a two-poster vectored thrust concept with flow visualization in the NASA Lewis 9- x 15-foot low speed wind tunnel
[NASA-TM-103258] N91-21116

Integrated flight/propulsion control system design based on a decentralized, hierarchical approach
[NASA-TM-103678] N91-21137

Integrated flight/propulsion control design for a STOVL aircraft using H-infinity control design techniques
[NASA-TM-104340] N91-21140

Fire suppression in human-crew spacecraft
[NASA-TM-104334] N91-21182

GaAs monolithic RF modules for SARSAT distress beacons
[NASA-TM-104338] N91-21184

A new fabrication method for precision antenna reflectors for space flight and ground test
[NASA-TP-3078] N91-21185

Magnetic bearings with zero bias N91-21194

Microgravity vibration isolation: An optimal control law for the one-dimensional case N91-21206

Cooling of in-situ propellant rocket engines for Mars mission
[NASA-TM-103729] N91-21233

Power technologies and the space future
[NASA-TM-103649] N91-21240

Mechanical behavior of fiber reinforced SiC/RBSN ceramic matrix composites: Theory and experiment
[NASA-TM-103688] N91-21243

Mechanical strength and thermophysical properties of PM212: A high temperature self-lubricating powder metallurgy composite
[NASA-TM-103694] N91-21302

Hydrocarbon-fuel/combustion-chamber-liner materials compatibility
[NASA-CR-187104] N91-21307

A simple test for thermomechanical evaluation of ceramic fibers
[NASA-TM-103767] N91-21309
An examination of anticipated g-jitter on space station and its effects on materials processes
[NASA-TM-103775] N91-21378
Optimal design study of high efficiency indium phosphide space solar cells
[NASA-TM-103763] N91-21433
CFD for hypersonic propulsion
[NASA-TM-103791] N91-21447
On the anomaly of velocity-pressure decoupling in collocated mesh solutions
[NASA-TM-103769] N91-21448
Application of computational fluid dynamics in high speed aeropropulsion
[NASA-TM-103780] N91-21458
Advanced rotorcraft transmission program
[NASA-TM-103276] N91-21531
Effects of gear box vibration and mass imbalance on the dynamics of multi-stage gear transmissions
[NASA-TM-103695] N91-21534
Fully articulated four-point-bend loading fixture
[NASA-CASE-LEW-14776-1] N91-21540
Spatial variations in ac susceptibility and microstructure for the YBa2Cu3O(7-x) superconductor and their correlation with room-temperature ultrasonic measurements
[NASA-TM-103787] N91-21553
Elastic response of zone axis (001)-oriented PWA 1480 single crystal: The influence of secondary orientation
[NASA-TM-103782] N91-21558
Applications of artificial neural nets in structural mechanics
[NASA-TM-102420] N91-21559
HITCAN for actively cooled hot-composite thermostructural analysis
[NASA-TM-103750] N91-21562
Asymptotic integration algorithms for nonhomogeneous, nonlinear, first order, ordinary differential equations
[NASA-TM-103793] N91-21797
Fiber optic sensing system
[NASA-CASE-LEW-14795-1] N91-21871
The series Bi2Sr2Ca(n-1) Cu(n)O(2n+4) (1 less than or equal to n less than or equal to 5): Phase stability and superconducting properties
[NASA-TM-103749] N91-21910

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. MARSHALL SPACE FLIGHT CENTER, HUNTSVILLE, AL.

O-ring gasket test fixture
[NASA-CASE-MFS-28376-1] N91-21175
A novel method of testing the shear strength of thick honeycomb composites
[NASA-TP-3108] N91-21242
An evaluation of GTAW-P versus GTA welding of alloy 718
[NASA-TM-103529] N91-21287
Reluctant glass formers and their applications in optical lens design N91-21351
GEOSIM: A numerical model for geophysical fluid flow simulation
[NASA-TM-103528] N91-21450
Wet atmospheric generation apparatus
[NASA-CASE-MFS-28177-1] N91-21496
Evaluation of bearing configurations using the single bearing tester in liquid nitrogen
[NASA-TM-103527] N91-21532
Sample holder support for microscopes
[NASA-CASE-MFS-28420-1] N91-21545
Atmospheric environment for space shuttle (STS-38) launch
[NASA-TM-103530] N91-21633

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. PASADENA OFFICE, CA.

Laterally stacked Schottky diodes for infrared sensor applications
[NASA-CASE-NPO-17426-1-CU] N91-21434
Method and apparatus for configuration control of redundant robots
[NASA-CASE-NPO-17801-1-CU] N91-21544
System and method for measuring ocean surface currents at locations remote from land masses using synthetic aperture radar
[NASA-CASE-NPO-17937-1-CU] N91-21621

NATIONAL AEROSPACE LAB., TOKYO (JAPAN).

Coning motion of slender bodies at high angles of attack
[NAL-TR-1059] N91-21111
Wind tunnel test of a propeller working in a low Reynolds number range
[NAL-TR-1071] N91-21112
An experimental study of a three-dimensional swept-back wing with suction laminar-flow-control
[NAL-TR-1072] N91-21113
Blunt trailing edge analysis of supercritical airfoils by a Navier-Stokes code
[NAL-TR-1075-T] N91-21114
The Japanese containerless experiments N91-21338
Proceedings of the 8th NAL Symposium on Aircraft Computational Aerodynamics: Prospects of Computational Fluid Dynamics and Super Computers in Aerospace Science and Technology
[NAL-SP-13] N91-21379
Computer requirements for further CFD development N91-21380
CFD development present and prospects at NAL N91-21385
Slant hot-wire inclination measurement using dual laser beams
[NAL-TR-1078] N91-21491
Effective cleaning of oil-protected bearing steel examined by XPS analysis. Part 1: Cleaning by solvents and alkaline cleaners
[NAL-TR-1074] N91-21538

NATIONAL AIR AND SPACE MUSEUM, WASHINGTON, DC.

Submillimeter observations with the Kuiper Airborne Observatory N91-21987

NATIONAL CENTER FOR ATMOSPHERIC RESEARCH, BOULDER, CO.

Survey of NCAR user needs for visualization tools. A research report of the Digital/NCAR joint research project
[PB91-115444] N91-21154
Global monthly sea surface temperature climatology
[PB91-129304] N91-21669

NATIONAL CENTER FOR PHYSICAL ACOUSTICS, UNIVERSITY, MS.

FY 1989 acoustics research
[AD-A231499] N91-21840

NATIONAL ENVIRONMENTAL SATELLITE SERVICE, WASHINGTON, DC.

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[PB91-129304] N91-21669

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[PB91-123356] N91-21960
Solar-geophysical data number 553, September 1990. Part 1: (Prompt reports). Data for August 1990, July 1990, and late data
[PB91-113019] N91-22059

NATIONAL INST. FOR FUSION SCIENCE, NAGOYA (JAPAN).

Observation of parallel viscosity in the CHS heliotron/torsatron
[NIFS-70] N91-21891
Spectral analysis of the heliotron field with the toroidal harmonic function in a study of the structure of built-in divertor
[NIFS-71] N91-21892
Effect of electric field inhomogeneities on drift wave instabilities and anomalous transport
[NIFS-72] N91-21893
Stabilities of regular motion in the relativistic standard map
[NIFS-73] N91-21894

NATIONAL INST. OF STANDARDS AND TECHNOLOGY, GAITHERSBURG, MD.

A dynamic technique for measuring surface tension at high temperatures in microgravity environment N91-21347
A high-speed spatial (linear) scanning pyrometer: A tool for diagnostics, temperature mapping, and property determinations at high temperatures N91-21361

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, BOULDER, CO.

Atmospheric methane data for the period 1986-1988 from the NOAA/CMDL global cooperative flask sampling network
[PB91-129122] N91-21626
Environmental Research Laboratories publication abstracts, fiscal year 1990
[PB91-132035] N91-21627
Calibration transfer target for a microwave radiometric profiling system
[PB91-129080] N91-21647
Estimations of ABL fluxes and other turbulence parameters from Doppler lidar data
[NASA-CR-188062] N91-21648

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[PB91-129098] N91-21667

NATIONAL SEVERE STORMS LAB., NORMAN, OK.

Gust front/wind shift detection algorithm for the terminal Doppler weather radar
[DOT/FAA/NR-91/4] N91-21671

NATIONAL TELECOMMUNICATIONS AND INFORMATION ADMINISTRATION, BOULDER, CO.

Design of experiments to quantify communication satellite system performance
[PB91-129635] N91-21395
Long-term performance and propagation measurements on single and tandem digital microwave transmission links. Volume 1: Analysis of measurement data
[PB91-129643] N91-21396
Long-term performance and propagation measurements on single and tandem digital microwave transmission links. Volume 2: Appendixes
[PB91-129650] N91-21397
Extended database of microwave common carrier antenna gain patterns
[PB91-119206] N91-21398

NATIONAL UNIV. OF SINGAPORE.

The simplification of fuzzy control algorithm and hardware implementation N91-21781

NATIONAL WEATHER SERVICE, SALT LAKE CITY, UT.

Stratus surge prediction along the Central California coast
[PB91-129239] N91-21668

NAVAL AEROSPACE MEDICAL RESEARCH LAB., PENSACOLA, FL.

Predicting F-14 Air Combat Maneuvering (ACM) performance using an automated battery of cognitive/psychomotor tests
[AD-A228593] N91-21128

NAVAL AIR DEVELOPMENT CENTER, WARMINSTER, PA.

Enhancing tolerance to acceleration (+Gz) stress: The Hook maneuver
[AD-A231094] N91-21707
The development of perceptual/motor and cognitive performance measures under a high-G environment: A preliminary study
[AD-A231289] N91-21709
Ventilation loss and pressurization in the NASA launch/entry suit: Potential for heat stress
[NASA-CR-188075] N91-21719

NAVAL BIODYNAMICS LAB., NEW ORLEANS, LA.

Physiology data acquisition system description
[AD-A231088] N91-21706

NAVAL ENVIRONMENTAL PREDICTION RESEARCH FACILITY, MONTEREY, CA.

Impact of icing on Unmanned Aerial Vehicle (UAV) operations
[AD-A231191] N91-21124
Satellite cloud analyses: A nowcasting capability for the US Navy's TESS(3)
[AD-A231120] N91-21676
The oceanic cloudy atmosphere: Measurement requirements and solution options
[AD-A231121] N91-21677
Cloud classification of DMSP visible and IR imagery using physical and textural features
[AD-A231186] N91-21680

NAVAL OCEAN SYSTEMS CENTER, SAN DIEGO, CA.

Specification for a standard radar sea clutter model
[AD-A230848] N91-21409

NAVAL OCEANOGRAPHIC AND ATMOSPHERIC RESEARCH LAB., BAY SAINT LOUIS, MS.

Tropical cyclone track objective aids for the microcomputer: PCLM, XTRP, PCHP
[AD-A230851] N91-21675
Implementation of an oceanographic expert system: Problems, feedback, solutions
[AD-A230886] N91-21689
Satellite altimetry for naval oceanography
[AD-A231081] N91-21691
Objective use of satellite altimetry and IR in simulations of western boundary current dynamics
[AD-A231628] N91-21695
High-frequency acoustic scattering
[AD-A230880] N91-21836
Scattering in the time domain from submerged elastic shells at coincidence frequencies
[AD-A231122] N91-21837
Transient solutions from scattered fields in a waveguide
[AD-A231124] N91-21838

NAVAL OCEANOGRAPHIC AND ATMOSPHERIC RESEARCH LAB., MONTEREY, CA.
Tactical Environmental Support System (TESS(3)) satellite cloud analyses
[AD-A231247] N91-21681
NAVAL POSTGRADUATE SCHOOL, MONTEREY, CA.
A perturbation solution of the main problem in artificial satellite theory
[AD-A231560] N91-21227
Performance of small thrusters and propulsion systems
[AD-A231482] N91-21241
An economic analysis of counterfeit threaded fasteners in the construction industry
[AD-A231492] N91-21551
ONR tropical cyclone motion research initiative: Field experiment summary
[AD-A231152] N91-21679
A toolkit for designing user interfaces
[AD-A231558] N91-21723
Classification of intermittent dependent observations
[AD-A231605] N91-21811
NAVAL RESEARCH LAB., WASHINGTON, DC.
Efficient approaches for report/cluster correlation in multitarget tracking systems
[AD-A231589] N91-21421
Transverse klystron
[AD-A231586] N91-21444
Free electron lasers
[AD-A230817] N91-21519
Noise effects upon a simple timing channel
[AD-A230818] N91-21726
Studies of synchrotron radiation emission from the NRL modified betatron accelerator
[AD-A231346] N91-21868
NAVAL UNDERWATER SYSTEMS CENTER, NEWPORT, RI.
Statistical properties of the sea surface sound dipole source
[AD-A230811] N91-21688
NEBRASKA UNIV., LINCOLN.
Comparison of UNL laser imaging and sizing system and a phase Doppler system for analyzing sprays from a NASA nozzle
[NASA-CR-185239] N91-21485
NEW ENGLAND RESEARCH, INC., WHITE RIVER JUNCTION, VT.
Physical property measurements on analog granites related to the joint verification experiment
[AD-A230571] N91-21650
NEW HAMPSHIRE UNIV., DURHAM.
A study of helium. Argon: Ethane gas mixtures used in drift chambers for large acceptance spectrometers in high magnetic fields
[AD-A231209] N91-21284
NEW MEXICO STATE HIGHWAY AND TRANSPORTATION DEPT., SANTA FE.
Assessment of the absolute accuracy of long-baseline kinematic GPS positioning of a moving vehicle
[PB91-129379] N91-21125
NEW YORK UNIV., NEW YORK.
Convergence of the point vortex method for the 3-D Euler equations
[AD-A231285] N91-21479
Cloud and ocean effects on global greenhouse warming
[DE91-008842] N91-21639
NIELSEN ENGINEERING AND RESEARCH, INC., MOUNTAIN VIEW, CA.
Prediction of unsteady transonic separated flow for missile applications
[AD-A231259] N91-21120
NIPPON ELECTRIC CO. LTD., TOKYO (JAPAN).
Parallelization techniques for a supercomputer with hierarchical memory architecture N91-21386
NORGES TEKNISKE HOEGSKOLE, TRONDHEIM.
Offshore technology R and D in space applications N91-21162
NORSK DATA A.S., OSLO.
Design of a processing facility for synthetic aperture radar data at the Tromso ERS-1 ground station N91-21161
NORTH CAROLINA AGRICULTURAL AND TECHNICAL STATE UNIV., GREENSBORO.
Studies of a direct drive robot with a parallel configuration
[AD-A231265] N91-21548
NORTH CAROLINA STATE UNIV., RALEIGH.
Integrated synthesis and post processing of silicon carbide and aluminum nitride
[AD-A230810] N91-21317
Graduate fellowship in hypersonics
[AD-A231263] N91-21478
Atomic layer epitaxy of silicon, silicon/germanium, and silicon carbide via extraction/exchange processes
[AD-A231348] N91-21927
NORTH CAROLINA UNIV., CHAPEL HILL.
Ex-situ and in-situ ellipsometric studies of the thermal oxide on InP
[AD-A231095] N91-21283
Single board system for fuzzy inference N91-21784
Optical switching and optical logic in a thermally expanding Si etalon
[AD-A230706] N91-21870
An investigation of Si-SiO2 interface charges in thermally oxidated (100), (110), (111), (511) silicon
[AD-A231244] N91-21923
NORTH CAROLINA UNIV., CHARLOTTE.
Five degree-of-freedom control of an ultra-precision magnetically-suspended linear bearing N91-21196
Nonlinear compensation techniques for magnetic suspension systems N91-21204
NORTHEASTERN UNIV., BOSTON, MA.
Chaotic spectra of small molecules
[AD-A231638] N91-21859
NORTHWEST ANALYSIS, BOZEMAN, MT.
The gravitomagnetic interaction and its relationship to other relativistic gravitational effects
[NASA-CR-187736] N91-21649
NORTHWESTERN UNIV., EVANSTON, IL.
Materials can be stressed out too
[AD-A231351] N91-21589
NORWEGIAN DEFENCE RESEARCH ESTABLISHMENT, KJELLER.
Specification of the autonomous missile guidance problem for the TA11 processor. Volume 4: Processor mini-spec
[FFI-90/4005-VOL-4] N91-21145
Specification of the autonomous missile guidance problem for the TA11 processor. Volume 6: Specification mode 16, N
[FFI-90/4005-VOL-6] N91-21146
Specification of the autonomous missile guidance problem for the TA11 processor. Volume 7: Specification mode 29, N + A + T + H
[FFI-90/4005-VOL-7] N91-21147
Specification of the autonomous missile guidance problem for the TA11 processor. Volume 8: Specification mode 30, N + A + T + B
[FFI-90/4005-VOL-8] N91-21148
Norwegian studies of plasma modifications around spacecraft and how these affect the vehicle potential N91-21166
NORWEGIAN SPACE CENTER, OSLO.
From Earth to space and back: Selected papers on Norwegian space activities
[NSC-REPT(90)2] N91-21159
Development of Norwegian space activities N91-21160
Space research in Norway N91-21167

O

OAK RIDGE NATIONAL LAB., TN.
Applications and current limitations of matrix-assisted laser desorption Fourier transform mass spectrometry for biomolecules
[DE91-008877] N91-21265
Rapid determination of drugs and semivolatile organics by direct thermal desorption ion trap mass spectrometry
[DE91-008885] N91-21278
Measurement of residual stresses by x ray diffraction near simulated heat affected zones in austenitic stainless steels
[DE91-008874] N91-21289
The nucleation and growth of polycrystalline silicon carbide
[DE91-008887] N91-21304
High-temperature metal purification using a compact, portable rf heating and levitation system on the wake shield N91-21363
Compact rf heating and levitation systems for the NASA modular electromagnetic levitator N91-21364
High temperature metal purification using a compact portable rf heating and levitation system on the wake shield N91-21365
Improving risk communication through interactive training in communication skills
[DE91-008366] N91-21402
Seminar on anthropogenic emissions of greenhouse gases
[DE91-009110] N91-21634
Using climate model output to assess the impacts of climate change on water resources
[DE91-004542] N91-21637
GRESS: A preprocessor for sensitivity studies on FORTRAN programs
[DE91-009561] N91-21751
Hypercube clock synchronization
[DE91-009222] N91-21774
The IBM RISC System/6000 and linear algebra operations
[DE91-009221] N91-21805
OBSERVATOIRE DE PARIS-MEUDON (FRANCE).
PRONAOS N91-22020
Submillimetre observations of solar-system objects N91-22037
OFFICE OF AIR QUALITY PLANNING AND STANDARDS, RESEARCH TRIANGLE PARK, NC.
Compilation of air pollutant emission factor. Volume 1, supplement C: Stationary point and area sources, fourth edition
[PB91-125906] N91-21630
OHIO STATE UNIV., COLUMBUS.
Theory of structure and properties of hydrogenated amorphous silicon
[DE91-009353] N91-21315
A system for the real-time display of radar and video images of targets
[NASA-CR-188058] N91-21394
Transitive, anti-symmetric relational attributes in structural description matching with applications to radar target identification
[AD-A231318] N91-21417
OHIO UNIV., ATHENS.
Theory of photon and electron induced reactions
[DE91-008993] N91-21842
Electron distortion effects in quasi-elastic electron scattering
[DE91-009034] N91-21843
OKLAHOMA UNIV., NORMAN.
Estimations of ABL fluxes and other turbulence parameters from Doppler lidar data
[NASA-CR-188053] N91-21665
OLD DOMINION UNIV., NORFOLK, VA.
Investigation of nose bluntness and angle of attack effects on slender bodies in viscous hypertension flows
[NASA-CR-188153] N91-21117
Ground-based testing of the dynamics of flexible space structures using band mechanisms
[NASA-CR-188154] N91-21576
WINTER 1990 hydrographics data report: CTD station profiles, sections, nutrients, SAIL, January - February 1990
[DE91-008286] N91-21686
ONSALA SPACE OBSERVATORY (SWEDEN).
A flexible hybrid spectrometer for balloon borne and ground based (sub)millimeter wavelength astronomy N91-22043
OPTICOMP CORP., ZEPHYR COVE, NV.
Digital optical computer global interconnect algorithm study
[AD-A230282] N91-21736
OSSERVATORIO ASTRONOMICO, PADOVA (ITALY).
Extragalactic source counts, confusion limits and contributions to the background radiation in the sub-mm N91-21995
OULU UNIV. (FINLAND).
Supervision of peat stockpiles using aerial thermography
[DE91-752966] N91-21622
OXFORD UNIV. (ENGLAND).
Modelling of the impact response of fibre-reinforced composites
[OUEL-1863/90] N91-21244
Effect of strain rate on the through-thickness elastic properties of woven laminates N91-21245
A new type of shear specimen for measuring the interlaminar shear strength under impact loading N91-21246
The interlaminar shear strength of woven carbon, woven glass and woven carbon/glass hybrid laminates under static and impact loading N91-21247
Analysis of failure in woven carbon/epoxy laminates under quasi-static and impact loading N91-21248
Stress wave propagation in hybrid composite materials N91-21249
Mechanical behaviour of composite materials under impact loading N91-21250

P

PACIFIC MISSILE TEST CENTER, POINT MUGU, CA.
Satellite-derived moisture-bogusing profiles for the Northwest Pacific Ocean
[AD-A231058] N91-21690
PACIFIC NORTHWEST LAB., RICHLAND, WA.
Graphical user interfaces in computational chemistry
[DE91-009116] N91-21267
Vibrational frequencies for model silicates: Extensions beyond molecular properties
[DE91-008828] N91-21310
Engineering property limitations of structural ceramics and ceramic composites above 1600 C
[DE91-009105] N91-21311

Contributions of conformational and structural defects to the hyper-polarizabilities of polymers
[DE91-009042] N91-21313

PARASOFT CORP., PASADENA, CA.
An automatic parallelization tool for sequential programs
[AD-A229972] N91-21771
A heterogeneous parallel programming capability
[AD-A229710] N91-21772

PENNSYLVANIA STATE UNIV., UNIVERSITY PARK.
Computation of supersonic and low subsonic cascade flows using an explicit Navier-Stokes technique and the kappa-epsilon turbulence model N91-21072
Distributed Minimal Residual (DMR) method for acceleration of iterative algorithms N91-21077
A pressure based method for the solution of viscous incompressible turbomachinery flows N91-21078
Wave models for turbulent free shear flows N91-21086
Comparison of the activity of subsurface and surface microorganisms and their anaerobic transformation of heterocyclic compounds
[DE91-008839] N91-21703
New materials and new techniques for imaging of long wavelength IR radiation
[AD-A231086] N91-21877
Kinetic stability of field-reversed configurations
[DE91-009530] N91-21901

PENNSYLVANIA UNIV., PHILADELPHIA.
On the massively parallel solution of the assignment problem
[AD-A230847] N91-21775
Magnetic quasicrystals
[AD-A231264] N91-21924

POLISH ACADEMY OF SCIENCES, WARSAW.
Deterministic and stochastic sensitivity in computational structural mechanics
[ISSN-0208-5658] N91-21571

POLYTECHNIC INST. OF NEW YORK, FARMINGDALE.
Experimental investigation of scattering of magnetostatic waves by surface acoustic waves
[DE91-009435] N91-21835

PRATT AND WHITNEY AIRCRAFT, WEST PALM BEACH, FL.
Large liquid rocket engine transient performance simulation system
[NASA-CR-184099] N91-21232
Advanced expander test bed program
[NASA-CR-187082] N91-21234

R

R AND D ASSOCIATES, LOS ANGELES, CA.
Improved fits for the vibrational and rotational constants of many states of nitrogen and oxygen
[AD-A229996] N91-21263

REGULATORY INFORMATION SERVICE CENTER, WASHINGTON, DC.
Unified agenda of Federal regulations, October 1990
[PB91-120527] N91-21984

RENSSELAER POLYTECHNIC INST., TROY, NY.
Aerobic production of ethanol
[PB91-119172] N91-21324

RESEARCH AND DATA SYSTEMS, INC., GREENBELT, MD.
Analysis of error in TOMS total ozone as a function of orbit and attitude parameters
[NASA-CR-4361] N91-21670

RESEARCH INST. FOR ADVANCED COMPUTER SCIENCE, MOFFETT FIELD, CA.
Normalized convergence rates for the PSMG method
[AD-A231311] N91-21764

RHODE ISLAND UNIV., NARRAGANSETT.
Sources of volcanic aerosols: Petrologic and volcanological constraints N91-21644

RICE UNIV., HOUSTON, TX.
Ultraviolet photoelectron spectra of gallium arsenide clusters
[AD-A224927] N91-21261
Thermophysical property measurements in electromagnetic levitators N91-21344
Surface tension and viscosity from damped free oscillations of viscous droplets N91-21346
A high temperature thermal diffusivity determination procedure for solids and liquids N91-21377

ROCHESTER UNIV., NY.
Photochemistry and charge transfer chemistry of the platinum group elements
[DE91-009153] N91-21277
Effects of source correlations on the spectrum of radiated fields
[AD-A230955] N91-21411
Stochastic and deterministic fluctuations in stimulated Brillouin scattering
[AD-A230988] N91-21522
Serrated circular apertures: Optical Fourier transforms and fractal analysis
[AD-A230834] N91-21874

ROCKWELL INTERNATIONAL CORP., CANOGA PARK, CA.
Numerical solutions of 2-D multi-stage rotor/stator unsteady flow interactions N91-21070
Heavy hydrocarbon main injector technology program
[NASA-CR-188082] N91-21235

ROCKWELL INTERNATIONAL SCIENCE CENTER, THOUSAND OAKS, CA.
Unstructured grid generation using the distance function N91-21065

ROME UNIV. (ITALY).
Sub-millimetric cosmology: From ground based to space observations N91-21991
The OASI observatory in Antarctica N91-22036
A millimeter and submillimeter balloon telescope for measurements of diffuse radiation N91-22040
The TIR project: A balloon telescope for the measurement of CBR anisotropies N91-22041
A high throughput, multiband photometer for the TIR project N91-22042

ROYAL AEROSPACE ESTABLISHMENT, FARNBOROUGH (ENGLAND).
A simple model vortex flow past a slender elliptic cone at incidence
[RAE-TM-AERO-2197] N91-21460

ROYAL NORWEGIAN COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH, KJELLER.
Operation, maintenance, and research activities at NORSAR, NORESS, and ARCESS
[AD-A230874] N91-21970

ROYAL OBSERVATORY, EDINBURGH (SCOTLAND).
SCUBA: A submillimetre camera N91-22044
Radiatively-cooled telescopes for infrared space astronomy N91-22048

S

SAN JOSE STATE UNIV., CA.
Stratus surge prediction along the Central California coast
[PB91-129239] N91-21668

SANDIA NATIONAL LABS., ALBUQUERQUE, NM.
Effect of equations of state on transient burning analysis of pyrotechnic materials in a closed system
[DE91-009167] N91-21280
CO2 induced inhibition of the localized corrosion of aluminum, Al-0.5 percent Cu, and Al-2 percent Cu in dilute HF solution
[DE91-005312] N91-21292
UV cured epoxy resin coatings
[DE91-008180] N91-21303
High temperature deformation of silicon
[DE91-009102] N91-21305
An evaluation of the effects of varying composition and processing on several encapsulating resins
[DE91-009101] N91-21314
How clean is clean. How clean is needed
[DE91-008173] N91-21391
Surface cleaning by laser ablation
[DE91-009189] N91-21505
A discussion of the xenon laser intensity as a function of pump rate
[DE91-009225] N91-21506
Optical properties of a nuclear reactor pumped gas laser
[DE91-009226] N91-21507
High efficiency surface-emitting semiconductor laser resonators
[DE91-005236] N91-21510
Theory of semiconductor laser feedback instability
[DE91-008198] N91-21512
A comparison of calculational results with experimental data for long rod projectiles
[DE91-009006] N91-21536
Update of PRONTO 2D and PRONTO 3D transient solid dynamics program
[DE91-009183] N91-21564
Dynamics of rotating flexible structures by a method of quadratic modes
[DE91-009224] N91-21565
Experimental laboratory system to generate high frequency test environments
[DE91-008252] N91-21583
A modified SLIC material interface reconstruction algorithm for Eulerian codes
[DE91-009175] N91-21740
Signal parameter algorithms for trend analysis of digital data acquisition systems
[DE91-008171] N91-21749
Stability analysis of time-dependent transport algorithms
[DE91-009170] N91-21750
Structural analysis on massively parallel computers
[DE91-009038] N91-21773
Uncertainty estimates for derivatives and intercepts
[DE91-004503] N91-21802
Chaotic and random processes
[DE91-008574] N91-21804
FWP executive summaries: Basic energy sciences, materials sciences programs
[DE91-009223] N91-21826
Dip coating of sol-gels
[DE91-007571] N91-21872
EBIC (Electron Beam Induced Current) contrast of clean, decorated and deuterium passivated Si(Ge) epitaxial misfit dislocations
[DE91-006967] N91-21912
On the crystal structure of boron carbides
[DE91-009256] N91-21914
Administrative information systems plan, FY 1991 - FY 1995
[DE91-008072] N91-21964
Relational databases with NIAM models bid so long to top-down designs
[DE91-009191] N91-21965

SANDIA NATIONAL LABS., LIVERMORE, CA.
Measurement capabilities of the Sandia, Livermore, Standards Laboratories
[DE91-008124] N91-21825

SATCON TECHNOLOGY CORP., CAMBRIDGE, MA.
A superconducting large-angle magnetic suspension N91-21191
Sliding mode control of magnetic suspensions for precision pointing and tracking applications N91-21193
Magnetic bearings for a spaceflight optical disk recorder N91-21195

SCIENCE APPLICATIONS INTERNATIONAL CORP., SAN DIEGO, CA.
Intelligent array system
[AD-A231107] N91-21792

SCIENTIFIC RESEARCH ASSOCIATES, INC., GLASTONBURY, CT.
Transport via moments of quantum distribution functions
[AD-A231182] N91-21821

SCRIPPS INSTITUTION OF OCEANOGRAPHY, LA JOLLA, CA.
Analysis of 200 Hz CW tone propagation signal recorded during the September 1987 VLA experiment
[AD-A231053] N91-21414
High resolution beamforming on large aperture vertical line arrays: Processing synthetic data
[AD-A231054] N91-21415
Probability estimates of cloud-obscured line-of-sight
[AD-A231151] N91-21678
A 200 Hz matched field processing on the September 1987 VLA data set
[AD-A231096] N91-21692
Interaction of surface waves and near surface currents
[AD-A231612] N91-21694

SEARCH TECHNOLOGY, INC., NORCROSS, GA.
Seven ways to make a hypertext project fail N91-21946

SMITHSONIAN ASTROPHYSICAL OBSERVATORY, CAMBRIDGE, MA.
A search for stellar occultations by Uranus, Neptune, Pluto, and their satellites: 1990-1999
[NASA-CR-188146] N91-22053

SOFTWARE AND ENGINEERING ASSOCIATES, INC., CARSON CITY, NV.
Boundary layer study. Phase 4: Experimental validation test plan
[AD-A231342] N91-21481
Boundary layer study
[AD-A231343] N91-21482

SOUTHAMPTON UNIV. (ENGLAND).
One way to reduce thermal effects in a piezoelectric pressure transducer mounted in the combustion chamber of a C.I. engine
[ISVR-TR-189] N91-21487

SPACE RESEARCH ORGANIZATION NETHERLANDS, GRONINGEN.
FIR and sub-mm direct detection spectrometers for spaceborne astronomy N91-22026
The mm and sub-mm wave planar antenna arrays for SIS detectors N91-22046

SRI INTERNATIONAL CORP., MENLO PARK, CA.
Laser probes of natural gas ignition chemistry
[PB91-127993] N91-21262
Theoretical investigation of energy storage in atomic and molecular systems: Metastable molecular fuels
[AD-A230854] N91-21852

STANFORD UNIV., CA.
Research studies on extreme ultraviolet and soft x ray lasers
[AD-A231033] N91-21523

Control of free-flying space robot manipulator systems
[NASA-CR-188026] N91-21527
Experiments in thrusterless robot locomotion control for space applications
[NASA-CR-188027] N91-21528
Experiments in cooperative-arm object manipulation with a two-armed free-flying robot
[NASA-CR-188028] N91-21529
Computer aided design tools and algorithms for submicron technologies
[AD-A231171] N91-21757
Interior-point methods for convex programming
[AD-A231372] N91-21765
Iterative procedures for exact maximum likelihood estimation in the first-order Gaussian moving average model
[AD-A230812] N91-21809
Bayesian analysis of constrained parameter and truncated data problems
[AD-A231080] N91-21810
Beam line and associated work
[AD-A231243] N91-21867

STATE UNIV. COLL. OF NEW YORK, BUFFALO.
Critical behavior in magnetic superlattices
[AD-A231327] N91-21925

STATE UNIV. OF NEW YORK, STONY BROOK.
Studies in clustering theory
[AD-A230967] N91-21475

STOCKHOLM OBSERVATORY (SWEDEN).
MOSES: A proposed Swedish submillimeter satellite for combined astronomical and atmospheric observations N91-22050

SUSSEX UNIV., BRIGHTON (ENGLAND).
Implementation of a matrix theorem prover for propositional modal logic
[INPE-5124-RPE/629] N91-21743

SVERDRUP TECHNOLOGY, INC., ARNOLD AFS, TN.
Evaluation of air injection in a sudden expansion diffuser for real-time afterburning application
[AD-A230850] N91-21141

SVERDRUP TECHNOLOGY, INC., BROOK PARK, OH.
A modal aeroelastic analysis scheme for turbomachinery blading
[NASA-CR-187089] N91-21138
Flat tensile specimen design for advanced composites
[NASA-CR-185261] N91-21252

SVERDRUP TECHNOLOGY, INC., CLEVELAND, OH.
Recent update of the RPLUS2D/3D codes N91-21094

SYRACUSE UNIV., NY.
Test generation for digital circuits using parallel processing
[AD-A231006] N91-21440

SYSTEMS TECHNOLOGY, INC., MOUNTAIN VIEW, CA.
Fully automatic guidance and control for rotorcraft nap-of-the-Earth flight following planned profiles. Volume 1: Real-time piloted simulation
[NASA-CR-177571-VOL-1] N91-21149
Fully automatic guidance and control for rotorcraft nap-of-the-Earth flight following planned profiles. Volume 2: Mathematical model
[NASA-CR-177571-VOL-2] N91-21150

T

TECHNICAL RESEARCH CENTRE OF FINLAND, ESPOO.
Use of natural gas and liquefied petroleum gas in heavy-duty engines
[DE91-752990] N91-21546

TECHNISCHE UNIV., BRUNSWICK (GERMANY, F.R.).
Identification of the aerodynamic model of the DLR research aircraft ATTAS from flight test data
[DLR-FB-90-40] N91-21130

TECOGEN, INC., WALTHAM, MA.
Development of a gas engine-driven chiller
[PB91-130237] N91-21389

TENNESSEE UNIV., KNOXVILLE.
The production and destruction of negative ions
[DE91-009517] N91-21850

TEXAS A&M UNIV., COLLEGE STATION.
Using fuzzy logic to integrate neural networks and knowledge-based systems N91-21788
Optimal Hankel-norm approximation and rational function models using impulse response data
[AD-A231317] N91-21839
Proton depth dose distribution: 3-D calculation of dose distributions from solar flare irradiation
[AD-A231230] N91-22061

TEXAS UNIV., ARLINGTON.
Electronic and ionic transport in processable conducting polymers
[AD-A231293] N91-21321

TEXAS UNIV., AUSTIN.
Assessment of the absolute accuracy of long-baseline kinematic GPS positioning of a moving vehicle
[PB91-129379] N91-21125
Controlling fundamentals in high-energy high-rate pulsed power materials processing of powdered tungsten, titanium aluminides, and copper-graphite composites
[AD-A230900] N91-21298
Electron transfer between glucose oxidase and electrodes via redox mediators bound with flexible chains to the enzyme surface
[AD-A231115] N91-21856

TEXAS UNIV. AT DALLAS, RICHARDSON.
Proof of the feasibility of coherent and incoherent schemes for pumping a gamma ray laser
[AD-A230897] N91-21520

THERMO ELECTRON TECHNOLOGIES CORP., SAN DIEGO, CA.
Laser diagnostics for plasma turbulence
[DE91-009377] N91-21899

THIOKOL CORP., BRIGHAM CITY, UT.
Flight set 360L007 (STS-33) insulation component. Volume 3: Final release
[NASA-CR-184091] N91-21230
Flight motor set 360T010 (STS-31R). Volume 1: System overview
[NASA-CR-184104] N91-21231

TOKYO UNIV. (JAPAN).
The University of Tokyo-Norbeyama Radio Observatory submillimeter survey telescope N91-22051

TOKYO UNIV., SAGAMIHARA (JAPAN).
Japanese space programmes of IR and sub-mm astronomy N91-21997
Large-scale (CII) 158 micron emission of the Galaxy observed by a balloon-borne telescope N91-22004

TOLEDO UNIV., OH.
A demonstration of CMOS VLSI circuit prototyping in support of the site facility using the 1.2 micron standard cell library developed by National Security Agency
[NASA-CR-188014] N91-21426
Measurements of scattering processes in negative ion-atom collisions
[DE91-009514] N91-21849

TRANSPORTATION RESEARCH BOARD, WASHINGTON, DC.
Transportation telecommunications
[PB91-123257] N91-21399

U

UNITED STATES MAN AND THE BIOSPHERE PROGRAM, WASHINGTON, DC.
Bibliography on the international network of biosphere reserves
[PB90-215518] N91-21600

UNITED TECHNOLOGIES RESEARCH CENTER, EAST HARTFORD, CT.
Theoretical investigation leading to energy storage in atomic and molecular systems
[AD-A231275] N91-21858

UNIVERSITY COLL., CARDIFF (WALES).
The microwave background: Its smoothness and frequency distribution as an astrophysical product N91-21992

UNIVERSITY OF SOUTH FLORIDA, SAINT PETERSBURG.
Large eddy simulation: Where do we stand
[AD-A230835] N91-21657

UNIVERSITY OF SOUTHERN CALIFORNIA, LOS ANGELES.
Environmentally-induced passivity of aluminum alloys and aluminum metal matrix composites
[AD-A231350] N91-21301
Fuzzy associative memories N91-21779
Thermal transport studies of optical coatings, interfaces and surfaces by thermal diffusion-wave interferometry
[AD-A231607] N91-21879
Optical NIPI device characterization
[AD-A231157] N91-21922
Kinetic aspects of lattice mismatch in molecular beam epitaxial growth on planar and patterned substrates
[AD-A231636] N91-21934

UNIVERSITY OF SOUTHERN CALIFORNIA, MARINA DEL REY.
A research program in computer technology
[AD-A231025] N91-21727

UNIVERSITY OF WEST FLORIDA, PENSACOLA.
Self-organization and clustering algorithms N91-21783

V

VANDERBILT UNIV., NASHVILLE, TN.
Very high temperature chemistry: Science justification for containerless experimentation in space N91-21334
NASA-sponsored containerless processing experiments N91-21335
Containerless processing projects N91-21336
The metrology of spherical shells using synchrotron x ray microtomography N91-21374
Drop coalescence studies N91-21375
Analysis of rolling contact spall life in 440 C steel bearing rims
[NASA-CR-184101] N91-21526

VIGYAN RESEARCH ASSOCIATES, INC., HAMPTON, VA.
Description and evaluation of an interference assessment for a slotted-wall wind tunnel
[NASA-CR-4352] N91-21155

VIRGINIA POLYTECHNIC INST. AND STATE UNIV., BLACKSBURG.
Velocity measurements in a turbulent trailing vortex and their application to BWI noise prediction
[NASA-CR-188083] N91-21100
Critical speeds and forced response solutions for active magnetic bearing turbomachinery, part 1 N91-21209
Critical speeds and forced response solutions for active magnetic bearing turbomachinery, part 2 N91-21210
Model correlation and damage location for large space truss structures: Secant method development and evaluation
[NASA-CR-188102] N91-21213
Large deformation behavior of long shallow cylindrical composite panels
[NASA-CR-4355] N91-21557
Thermal buckling and postbuckling of symmetrically laminated composite plates
[NASA-CR-188030] N91-21560
A method for the geometrically nonlinear analysis of compressively loaded prismatic composite structures
[NASA-CR-184846] N91-21561

VIRGINIA UNIV., CHARLOTTESVILLE.
Control issues of microgravity vibration isolation N91-21192

VOUGHT CORP., DALLAS, TX.
Shuttle Entry Air Data System (SEADS) hardware development. Volume 1: Summary
[NASA-CR-166044-VOL-1] N91-21179
Shuttle Entry Air Data System (SEADS) hardware development. Volume 2: History
[NASA-CR-166044-VOL-2] N91-21180

W

WARREN-FORTHOUGHT, INC., ANGLETON, TX.
The object the metaphor the power and evergreen or the eighth way to make a hypermedia project fail N91-21947

WASHINGTON STATE UNIV., PULLMAN.
Acoustic emission-fracture strength relations for Al/Gr composites
[DE91-009106] N91-21251
Optical scattering methods applicable to drops and bubbles N91-21358
Rapidly convergent algorithms for nonsmooth optimization
[AD-A231110] N91-21756

WASHINGTON UNIV., SEATTLE.
General three-dimensional disturbances to inviscid Couette flow
[DE91-009593] N91-21474
Report of the panel on the land surface: Process of change, section 5 N91-21594
On the response of the special sensor microwave/imager to the marine environment: Implications for atmospheric parameter retrievals
[NASA-CR-188032] N91-21664

WEAPONS SYSTEMS RESEARCH LAB., ADELAIDE (AUSTRALIA).
Basic rheology and its application to nitrocellulose propellant processing by screw mix-extruders
[AD-A230872] N91-21326

WICHITA STATE UNIV., KS.
Comparison of the post-buckling behavior of metallic and composite plates with centrally located cu touts
[PB91-118844] N91-21563

WISCONSIN UNIV., MADISON.
Containerless processing of undercooled melts N91-21339
Supercritical microgravity droplet vaporization N91-21354
Adaptive detection in subspaces
[AD-A231023] N91-21876

WORLD HEALTH ORGANIZATION, GENEVA (SWITZERLAND).
International document on food irradiation
[DE91-615879] N91-21715
WRIGHT RESEARCH DEVELOPMENT CENTER, WRIGHT-PATTERSON AFB, OH.
An experimental study of exit flow patterns in a multistage compressor in rotating stall
[AD-A231353] N91-21143
The mechanical property data base from an Air Force/industry cooperative test program on advanced aluminum alloys (8090 extrusion)
[AD-A230903] N91-21299
VHSIC Hardware Description Language (VHDL) benchmark suite
[AD-A231276] N91-21761

X

XEROX PALO ALTO RESEARCH CENTER, CA.
Comparing structurally different views of a VLSI design
[PB91-111757] N91-21425

Y

YALE UNIV., NEW HAVEN, CT.
Rheological properties, shape oscillations, and coalescence of liquid drops with surfactants
N91-21357

Typical Contract Number Index Listing

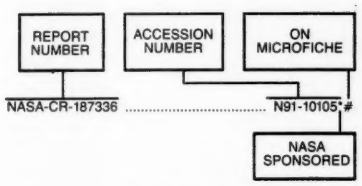
Listings in this index are arranged alphanumerically by contract number. Under each contract number the accession numbers denoting documents that have been produced as a result of research done under that contract are arranged in ascending order. The accession number denotes the number by which the citation is identified.

AF PROJ. 2302 ..... N91-21260
N91-21441
AF PROJ. 2303 ..... N91-21859
AF PROJ. 2304 ..... N91-21756
N91-21769
AF PROJ. 2305 ..... N91-21777
AF PROJ. 2306 ..... N91-21879
N91-21932
N91-21934
AF-AFOSR-0011-90 ..... N91-21793
AF-AFOSR-0038-88 ..... N91-21879
AF-AFOSR-0049-88 ..... N91-21859
AF-AFOSR-0059-88 ..... N91-21769
AF-AFOSR-0078-86 ..... N91-21775
AF-AFOSR-0093-90 ..... N91-21456
N91-21801
AF-AFOSR-0096-90 ..... N91-21093
AF-AFOSR-0129-87 ..... N91-21244
AF-AFOSR-0166-86 ..... N91-21934
AF-AFOSR-0180-88 ..... N91-21756
AF-AFOSR-0252-90 ..... N91-21441
AF-AFOSR-0258-88 ..... N91-21777
AF-AFOSR-0288-85 ..... N91-21066
AF-AFOSR-0288-89 ..... N91-21260
AF-AFOSR-0352-86 ..... N91-21479
AF-AFOSR-0376-87 ..... N91-21932
ARO-MIPR-105-90 ..... N91-21523
ARPA ORDER 4138 ..... N91-21970
ARPA ORDER 4242 ..... N91-21727
ARPA ORDER 5307 ..... N91-21650
BMVG-T/R-760/K-0007/K-1707 ..... N91-21151
BMVG-T/R-760/K-0012/K-1712 ..... N91-21173
CS-10-88 ..... N91-22016
DA PROJ. 1L1-61102-AH-43 ..... N91-21328
DA PROJ. 1L1-61102-AH-45 ..... N91-21243
DA PROJ. 1L1-62211-A-47-A N91-21531
N91-21534
DAAE07-84-C-R047 ..... N91-21533
DAAE07-85-C-R054 ..... N91-21533
DAAG29-85-K-0107 ..... N91-21921
DAAG29-85-K-0261 ..... N91-21917
DAAL03-86-G-0039 ..... N91-21478
DAAL03-86-G-0044 ..... N91-21072
DAAL03-86-K-0020 ..... N91-21438
DAAL03-86-K-0034 ..... N91-21318
DAAL03-86-K-0056 ..... N91-21153
DAAL03-86-K-0109 ..... N91-21759
DAAL03-86-K-0173 ..... N91-21411
N91-21522
N91-21874
DAAL03-87-C-0008 ..... N91-21120
DAAL03-87-K-0073 ..... N91-21298
DAAL03-87-K-0075 ..... N91-21319
DAAL03-87-K-0077 ..... N91-21757
DAAL03-87-K-0137 ..... N91-21476
DAAL03-87-K-0148 ..... N91-21281
DAAL03-87-K-0149 ..... N91-21924
DAAL03-87-K-0152 ..... N91-21877
DAAL03-88-K-0115 ..... N91-21439
DAAL03-88-K-0121 ..... N91-21320
DAAL03-88-K-0195 ..... N91-21499
DAAL03-89-G-0109 ..... N91-21548
DAAL03-89-K-0033 ..... N91-21809
DAAL03-89-K-0131 ..... N91-21317
DAAL03-89-K-0141 ..... N91-21876
DAAL03-90-C-0005 ..... N91-21821
DAAL03-90-G-0077 ..... N91-21806
DACA76-85-C-0010 ..... N91-21766
N91-21767
DACW39-89-M-5054 ..... N91-21974
DASG60-88-C-0040 ..... N91-21193
DE-AC02-76CH-00016 ..... N91-21271
N91-21293
N91-21294
N91-21295
N91-21296
N91-21513
N91-21515
N91-21725
N91-21835
N91-21873
N91-21916
DE-AC02-76CH-03000 ..... N91-21655
N91-21848
N91-21864
N91-22055
DE-AC02-76CH-03073 ..... N91-21889
DE-AC03-76SF-00098 ..... N91-21290
N91-21291
N91-21297
N91-21436
N91-21508
N91-21586
N91-21844
N91-21906
N91-21907
N91-21913
N91-21968
DE-AC03-89ER-51114 ..... N91-21887
N91-21888
DE-AC04-76DP-00613 ..... N91-21535
DE-AC04-76DP-00789 ..... N91-21280
N91-21292
N91-21303
N91-21305
N91-21314
N91-21391
N91-21505
N91-21506
N91-21507
N91-21510
N91-21512
N91-21536
N91-21564
N91-21565
N91-21583
N91-21740
N91-21749
N91-21750
N91-21773
N91-21802
N91-21804
N91-21826
N91-21872
N91-21912
N91-21914
N91-21964
N91-21965
DE-AC04-76DR-00789 ..... N91-21825
DE-AC04-88DP-43495 ..... N91-21861
DE-AC05-84OR-21400 ..... N91-21265
N91-21278
N91-21289
N91-21304
N91-21363
N91-21364
N91-21402
N91-21634
N91-21637
N91-21751
N91-21774
N91-21805
N91-21882
N91-21883
N91-21884
N91-21885
N91-21886
N91-21897
DE-AC06-76RL-01830 ..... N91-21251
N91-21267
N91-21310
N91-21311
N91-21313
DE-AC22-90PC-90044 ..... N91-21325
DE-AI01-76ET-20320 ..... N91-21625
DE-AI01-85CE-50162 ..... N91-21302
DE-AI01-86CE-90237 ..... N91-21264
DE-FG02-85ER-40235 ..... N91-21851
DE-FG02-86ER-13597 ..... N91-21461
DE-FG02-87ER-40342 ..... N91-21889
DE-FG02-87ER-40370 ..... N91-21842
N91-21843
DE-FG02-87ER-45310 ..... N91-21905
DE-FG02-87ER-60556 ..... N91-21703
DE-FG02-88ER-13969 ..... N91-21698
DE-FG02-88ER-45347 ..... N91-21315
DE-FG02-88ER-53276 ..... N91-21889
DE-FG02-88ER-60678 ..... N91-21702
DE-FG02-90ER-14125 ..... N91-21277
DE-FG02-90ER-53302 ..... N91-21901
DE-FG02-90ER-61014 ..... N91-21639
DE-FG03-90ER-54088 ..... N91-21899
DE-FG03-90SF-18438 ..... N91-21900
DE-FG05-85ER-13456 ..... N91-21850
DE-FG05-85ER-45194 ..... N91-21316
DE-FG05-85ER-60348 ..... N91-21686
DE-FG05-87ER-13708 ..... N91-21517
DE-FG05-88ER-13971 ..... N91-21849
DE-FG06-88ER-25061 ..... N91-21474
DE-FG22-89PC-89775 ..... N91-21272
DI-14-12-0001-30297 ..... N91-21961
DLA900-88-D-0392 ..... N91-21502
DNA001-88-C-0046 ..... N91-21263
DRET-88/214 ..... N91-21831
DTFA01-80-Y-10524 ..... N91-21671
DTFA03-88-C-00024 ..... N91-21122
EPA-68-01-7481 ..... N91-21985
ESA-6648/86/NL/PB N91-22046
ESA-6899/86/NL(SC) N91-21164
ESA-7898/88/NL/PB(SC) N91-22046
FINEP-537/CT N91-22060
F04611-86-C-0055 ..... N91-21481
N91-21482
F04611-86-C-0070 ..... N91-21852
F04611-86-C-0071 ..... N91-21858
F04611-87-C-0026 ..... N91-21329
F04611-88-C-0023 ..... N91-21855
F04701-88-C-0089 ..... N91-21178
N91-21547
N91-21878
N91-21904
F08606-89-C-0005 ..... N91-21970
F19628-86-K-0018 ..... N91-21881
F19628-88-K-0005 ..... N91-21678
F19628-89-C-0097 ..... N91-21650
F19628-90-C-0002 ..... N91-21437
F30602-88-D-0027 ..... N91-21440
F30602-88-D-0028 ..... N91-21922
F33615-85-C-4503 ..... N91-21710
F33615-87-C-1454 ..... N91-21782
F33615-87-C-2821 ..... N91-21080
N91-21081
F33615-87-D-0627 ..... N91-22061
F33615-88-C-0003 ..... N91-21734
F33615-89-C-0532 ..... N91-21716
N91-21718
F33615-89-C-3610 ..... N91-21735
F40600-85-C-0020 ..... N91-21501
F40600-85-C-0026 ..... N91-21142
F49620-85-C-0027 ..... N91-21068
F49620-87-C-0065 ..... N91-21480
F49620-87-C-0074 ..... N91-21732
F49620-88-C-0120 ..... N91-21523
F49620-89-C-0096 ..... N91-21090
GRI-5084-293-1135 ..... N91-21389
GRI-5087-260-1444 ..... N91-21262
MDA903-81-C-0335 ..... N91-21727

MDA903-87-C-0037 ..... N91-21792
MDA903-89-C-0003 ..... N91-21931
NAC-817 ..... N91-21078
NAGW-533 ..... N91-22057
NAGW-674 ..... N91-21139
NAGW-951 ..... N91-21452
NAGW-1490 ..... N91-22053
NAGW-1809 ..... N91-21101
NAG1-168 ..... N91-21580
NAG1-343 ..... N91-21560
N91-21561
NAG1-363 ..... N91-21117
NAG1-633 ..... N91-21795
NAG1-830 ..... N91-21576
NAG1-875 ..... N91-21733
NAG1-960 ..... N91-21213
NAG1-1021 ..... N91-21729
NAG1-1056 ..... N91-21202
NAG1-1117 ..... N91-21576
NAG1-1119 ..... N91-21100
NAG1-1145 ..... N91-21456
N91-21801
NAG2-208 ..... N91-21996
NAG2-254 ..... N91-22016
NAG2-379 ..... N91-21829
NAG2-485 ..... N91-22056
NAG2-542 ..... N91-21394
NAG2-547 ..... N91-21492
NAG2-593 ..... N91-21770
NAG2-656 ..... N91-21939
NAG3-230 ..... N91-21061
NAG3-634 ..... N91-21485
NAG3-660 ..... N91-21066
NAG3-716 ..... N91-21068
NAG3-776 ..... N91-21880
NAG3-877 ..... N91-21090
NAG3-948 ..... N91-21236
NAG3-968 ..... N91-21207
NAG3-1036 ..... N91-21426
NAG5-713 ..... N91-21673
NAG5-943 ..... N91-21664
NAG5-1379 ..... N91-21648
N91-21665
NAG8-803 ..... N91-21728
NASA ORDER C-99066-G N91-21071
N91-21074
N91-21082
N91-21083
NASA ORDER H-11215-D N91-21649
NASW-4292 ..... N91-21704
NAS1-16000 ..... N91-21179
N91-21180
NAS1-18585 ..... N91-21084
N91-21095
N91-21155
NAS1-18599 ..... N91-21084
N91-21089
NAS1-18605 ..... N91-21099
N91-21139
N91-21451
N91-21453
N91-21454
N91-21455
N91-21456
N91-21457
N91-21724
N91-21796
N91-21800
N91-21801
NAS1-18845 ..... N91-21198
NAS1-18935 ..... N91-21581
NAS2-11934 ..... N91-21121
N91-21714
NAS2-12640 ..... N91-21149
N91-21150
NAS3-25070 ..... N91-21307
NAS3-25266 ..... N91-21094
N91-21138
N91-21182
N91-21252
N91-21558
N91-21625
NAS3-25801 ..... N91-21430
NAS3-25960 ..... N91-21234
NAS5-29373 ..... N91-21670
NAS5-30309 ..... N91-21195
NAS7-918 ..... N91-21434
N91-21544
N91-21621
NAS8-30490 ..... N91-21230
N91-21231
NAS8-32828 ..... N91-22063
NAS8-36369 ..... N91-21235
NAS8-36994 ..... N91-21232
NAS8-37682 ..... N91-21239
NAS8-37764 ..... N91-21526
NAS8-38607 ..... N91-21530
NAS8-40000 ..... N91-21070
NAS9-17900 ..... N91-21427
NAS10-11624 ..... N91-21635
NCCW-10 ..... N91-21463
NCC1-15 ..... N91-21557
NCC1-68 ..... N91-21117
NCC2-333 ..... N91-21527
N91-21528
N91-21529
NCC3-81 ..... N91-21243
NCC3-135 ..... N91-21489
NCC9-16 ..... N91-21403
N91-21739
N91-21741
N91-21776
N91-21789
N91-21790
N91-21791
N91-21940
N91-21955
N91-21966
NOAA-NA85RAH05045 ..... N91-21666
NSF ASC-88-19373 ..... N91-21724
NSF ASC-88-19374 ..... N91-21724
NSF ASC-90-05874 ..... N91-21456
N91-21801
NSF AST-88-18327 ..... N91-22015
NSF ATM-86-15424 ..... N91-21673
NSF ATM-86-17735 ..... N91-21665
NSF BNS-85-18675 ..... N91-21782
NSF CBT-88-14655 ..... N91-21080
NSF DDM-87-15153 ..... N91-21765
NSF DMO-86-17355 ..... N91-21550
NSF DMS-87-13246 ..... N91-21455
NSF DMS-88-10150 ..... N91-21456
N91-21801
NSF ECS-87-15811 ..... N91-21793
NSF IRI-88-08896 ..... N91-21549
NSF IRI-90-03252 ..... N91-21783
NSG-3266 ..... N91-21078
N00014-75-C-0225 ..... N91-21693
N00014-80-C-0116 ..... N91-21589
N00014-84-C-0708 ..... N91-21322
N91-21521
N91-21926
N00014-84-K-0557 ..... N91-21282
N00014-85-C-0518 ..... N91-21682
N00014-85-K-0124 ..... N91-21766
N91-21767
N00014-86-C-0301 ..... N91-21392
N91-21393
N00014-86-C-2197 ..... N91-21421
N00014-86-K-0600 ..... N91-21782
N00014-86-K-0685 ..... N91-21500
N91-21766
N00014-86-K-0691 ..... N91-21454
N00014-86-K-0754 ..... N91-21453
N00014-87-F-0066 ..... N91-21519
N00014-87-K-0495 ..... N91-21853
N00014-87-K-0527 ..... N91-21928
N00014-88-J-1200 ..... N91-21867
N00014-88-K-0034 ..... N91-21301
N00014-88-K-0279 ..... N91-21480
N00014-88-K-0553 ..... N91-21261
N00014-88-K-0591 ..... N91-21550
N00014-88-K-0632 ..... N91-21549
N00014-89-C-0225 ..... N91-21736
N00014-89-J-1154 ..... N91-21694
N00014-89-J-1164 ..... N91-21477
N00014-89-J-1178 ..... N91-21283
N91-21870
N91-21923
N00014-89-J-1627 ..... N91-21810
N00014-89-J-1739 ..... N91-21840
N00014-89-J-1754 ..... N91-21658
N00014-89-J-1786 ..... N91-21929
N00014-89-J-1849 ..... N91-21918
N91-21919
N91-21920
N00014-89-J-1904 ..... N91-21927
N00014-89-J-1946 ..... N91-21550
N00014-89-J-1964 ..... N91-21794
N00014-89-J-1988 ..... N91-21775
N00014-89-K-0038 ..... N91-21414
N91-21415
N91-21692
N00014-90-C-0141 ..... N91-21771
N00014-90-C-0179 ..... N91-21772
N00014-90-C-0226 ..... N91-21930
N00014-90-C-2033 ..... N91-21422
N00014-90-J-1193 ..... N91-21925
N00014-90-J-1200 ..... N91-21417
N00014-90-J-1242 ..... N91-21765
N00014-90-J-1320 ..... N91-21321
N00014-90-J-1376 ..... N91-21285
N00014-90-J-1475 ..... N91-21857
N00014-90-J-1731 ..... N91-21475
N00014-90-J-1901 ..... N91-21323
N00014-90-J-4120 ..... N91-21657
N91-21758
N00014-90-K-2001 ..... N91-21520
N00039-88-C-0065 ..... N91-21419
N00140-87-C-8904 ..... N91-21770
N62190-89-M-1536 ..... N91-21839
PROJ. RM3-3-M-20 ..... N91-21794
PROJ. 20-5 ..... N91-21399
R-005840 ..... N91-21629
W-31-109-ENG-38 ..... N91-21266
N91-21449
N91-21582
N91-21748
N91-21803
W-7405-ENG-36 ..... N91-21226
N91-21275
N91-21288
N91-21462
N91-21585
N91-21812
N91-21813
N91-21814
N91-21816
N91-21817
N91-21818
N91-21819
N91-21841
N91-21862
N91-21865
W-7405-ENG-48 ..... N91-21273
N91-21274
N91-21276
N91-21312
N91-21407
N91-21462
N91-21488
N91-21497
N91-21498
N91-21503
N91-21504
N91-21509
N91-21511
N91-21516
N91-21518
N91-21554
N91-21584
N91-21638
N91-21656
N91-21808
N91-21815
N91-21898
N91-21902
N91-21903
N91-21915
W-7405-ENG-82 ..... N91-21279
W12-77 ..... N91-21422
199-04-16-11 ..... N91-21860
307-51-00 ..... N91-21910
323-53-62 ..... N91-21182
326-81-20-02 ..... N91-21183
342-02-00 ..... N91-21184
465-44-11 ..... N91-21641
476-14-06-01 ..... N91-21225
476-14-15-01 ..... N91-21214
N91-21581
505-61-11 ..... N91-21828
505-61-51 ..... N91-21829
505-62-0K N91-21531
505-62-21 ..... N91-21062
505-62-50 ..... N91-21137
N91-21140
505-62-52 ..... N91-21060
N91-21061
N91-21448
N91-21458
505-62-71 ..... N91-21116
505-62-71-01 ..... N91-21059
505-62-91 ..... N91-21115
505-63-1B N91-21138
N91-21559
505-63-01-11 ..... N91-21556
505-63-21 ..... N91-21127
505-63-31 ..... N91-21446
505-63-50-01 ..... N91-21306
N91-21308
505-63-50-09 ..... N91-21557
505-63-50-13 ..... N91-21177
505-63-51 ..... N91-21534
N91-21834
505-64-00 ..... N91-22066
505-64-12 ..... N91-21132
505-64-20-01 ..... N91-21144
505-66-29 ..... N91-21131

505-66-71 ..... N91-21587
505-68-11 ..... N91-21485
505-68-84 ..... N91-21134
505-90-52-01 ..... N91-21099
N91-21139
N91-21451
N91-21453
N91-21454
N91-21455
N91-21456
N91-21457
N91-21724
N91-21796
N91-21800
N91-21801
506-40-91 ..... N91-21471
506-41-3F N91-21430
506-41-11 ..... N91-21433
506-43-00 ..... N91-21286
506-43-11 ..... N91-21553
506-43-41-01 ..... N91-21577
N91-21580
506-49-21 ..... N91-21223
N91-21224
N91-21240
506-62-21 ..... N91-21447
510-01-01 ..... N91-21252
510-01-50 ..... N91-21243
N91-21309
533-02-51 ..... N91-21135
553-13-00 ..... N91-21558
N91-21797
590-14-11-02 ..... N91-21186
N91-21188
N91-21203
590-14-21-01 ..... N91-21573
N91-21574
N91-21575
590-14-31-01 ..... N91-21579
590-14-61-01 ..... N91-21572
N91-21578
590-21-21 ..... N91-21233
590-32-31-01 ..... N91-21435
593-12-41 ..... N91-21234
650-60-20 ..... N91-21185
763-01-41 ..... N91-21562
776-33-41 ..... N91-21625
778-34-22 ..... N91-21302

Typical Report Number Index Listing



Listings in this index are arranged alphanumerically by report number. The accession number denotes the number by which the citation is identified. An asterisk (*) indicates that the item is a NASA report. A pound sign (#) indicates that the item is available on microfiche.

A-88081 ..... N91-21470* #
A-89038 ..... N91-21828* #
A-90178 ..... N91-21131* #
A-90269 ..... N91-21829* #
A-91003 ..... N91-21471* #
A-91058 ..... N91-21134* #
A-91088 ..... N91-22066* #

AAMRL-TR-90-030 ..... N91-21716 #
AAMRL-TR-90-031 ..... N91-21718 #

AD-A224927 ..... N91-21261 #
AD-A224938 ..... N91-21229 #
AD-A228593 ..... N91-21128 #
AD-A229710 ..... N91-21772 #
AD-A229932 ..... N91-21735 #
AD-A229956 ..... N91-21716 #
AD-A229972 ..... N91-21771 #
AD-A229996 ..... N91-21263 #
AD-A230026 ..... N91-21717 #
AD-A230110 ..... N91-21904 #
AD-A230134 ..... N91-21552 #
AD-A230140 ..... N91-21486 #
AD-A230237 ..... N91-21718 #
AD-A230243 ..... N91-21533 #
AD-A230282 ..... N91-21736 #
AD-A230283 ..... N91-21777 #
AD-A230318 ..... N91-21719* #
AD-A230332 ..... N91-21460 #
AD-A230370 ..... N91-21400 #
AD-A230571 ..... N91-21650 #
AD-A230598 ..... N91-21737 #
AD-A230605 ..... N91-21428 #
AD-A230608 ..... N91-21962 #
AD-A230609 ..... N91-21401 #
AD-A230634 ..... N91-21881 #
AD-A230655 ..... N91-21869 #
AD-A230659 ..... N91-21738 #
AD-A230702 ..... N91-21429 #
AD-A230706 ..... N91-21870 #
AD-A230771 ..... N91-21963 #
AD-A230810 ..... N91-21317 #
AD-A230811 ..... N91-21688 #
AD-A230812 ..... N91-21809 #
AD-A230813 ..... N91-21752 #
AD-A230814 ..... N91-21753 #
AD-A230817 ..... N91-21519 #
AD-A230818 ..... N91-21726 #
AD-A230823 ..... N91-21437 #
AD-A230825 ..... N91-21256 #
AD-A230826 ..... N91-21118 #
AD-A230834 ..... N91-21874 #
AD-A230835 ..... N91-21657 #
AD-A230836 ..... N91-21969 #
AD-A230838 ..... N91-21438 #
AD-A230839 ..... N91-21318 #
AD-A230846 ..... N91-21408 #
AD-A230847 ..... N91-21775 #
AD-A230848 ..... N91-21409 #
AD-A230850 ..... N91-21141 #
AD-A230851 ..... N91-21675 #
AD-A230853 ..... N91-21257 #
AD-A230854 ..... N91-21852 #
AD-A230864 ..... N91-21820 #
AD-A230868 ..... N91-21136 #
AD-A230872 ..... N91-21326 #
AD-A230874 ..... N91-21970 #
AD-A230880 ..... N91-21836 #
AD-A230881 ..... N91-21711 #
AD-A230886 ..... N91-21689 #
AD-A230897 ..... N91-21520 #
AD-A230899 ..... N91-21555 #
AD-A230900 ..... N91-21298 #
AD-A230903 ..... N91-21299 #
AD-A230910 ..... N91-21521 #
AD-A230911 ..... N91-21853 #
AD-A230938 ..... N91-21588 #
AD-A230951 ..... N91-21410 #
AD-A230954 ..... N91-21917 #
AD-A230955 ..... N91-21411 #
AD-A230956 ..... N91-21854 #
AD-A230964 ..... N91-21875 #
AD-A230965 ..... N91-21499 #
AD-A230966 ..... N91-21319 #
AD-A230967 ..... N91-21475 #
AD-A230973 ..... N91-21327 #
AD-A230982 ..... N91-21412 #
AD-A230983 ..... N91-21178 #
AD-A230988 ..... N91-21522 #
AD-A230989 ..... N91-21281 #
AD-A230995 ..... N91-21133 #
AD-A230998 ..... N91-21439 #
AD-A230999 ..... N91-21300 #
AD-A231000 ..... N91-21971 #
AD-A231001 ..... N91-21972 #
AD-A231003 ..... N91-21547 #
AD-A231006 ..... N91-21440 #
AD-A231014 ..... N91-21500 #
AD-A231019 ..... N91-21754 #
AD-A231020 ..... N91-21328 #
AD-A231023 ..... N91-21876 #
AD-A231025 ..... N91-21727 #
AD-A231026 ..... N91-22058 #
AD-A231027 ..... N91-21258 #
AD-A231028 ..... N91-21119 #
AD-A231029 ..... N91-21259 #
AD-A231030 ..... N91-21755 #
AD-A231031 ..... N91-21413 #
AD-A231033 ..... N91-21523 #
AD-A231044 ..... N91-21918 #
AD-A231045 ..... N91-21282 #
AD-A231046 ..... N91-21919 #
AD-A231047 ..... N91-21920 #
AD-A231048 ..... N91-21501 #
AD-A231053 ..... N91-21414 #
AD-A231054 ..... N91-21415 #
AD-A231058 ..... N91-21690 #
AD-A231062 ..... N91-21855 #
AD-A231072 ..... N91-21320 #
AD-A231073 ..... N91-21476 #
AD-A231077 ..... N91-21158 #
AD-A231080 ..... N91-21810 #
AD-A231081 ..... N91-21691 #
AD-A231086 ..... N91-21877 #
AD-A231088 ..... N91-21706 #
AD-A231094 ..... N91-21707 #
AD-A231095 ..... N91-21283 #
AD-A231096 ..... N91-21692 #
AD-A231107 ..... N91-21792 #
AD-A231110 ..... N91-21756 #
AD-A231115 ..... N91-21856 #
AD-A231120 ..... N91-21676 #
AD-A231121 ..... N91-21677 #
AD-A231122 ..... N91-21837 #
AD-A231124 ..... N91-21838 #
AD-A231125 ..... N91-21921 #
AD-A231135 ..... N91-21693 #
AD-A231151 ..... N91-21678 #
AD-A231152 ..... N91-21679 #
AD-A231153 ..... N91-21441 #
AD-A231154 ..... N91-21857 #
AD-A231157 ..... N91-21922 #
AD-A231165 ..... N91-21973 #
AD-A231166 ..... N91-21623 #
AD-A231171 ..... N91-21757 #
AD-A231182 ..... N91-21821 #
AD-A231185 ..... N91-21708 #
AD-A231186 ..... N91-21680 #
AD-A231188 ..... N91-21806 #
AD-A231191 ..... N91-21124 #
AD-A231196 ..... N91-21524 #
AD-A231203 ..... N91-21416 #
AD-A231205 ..... N91-21477 #
AD-A231209 ..... N91-21284 #
AD-A231220 ..... N91-21758 #
AD-A231226 ..... N91-21759 #
AD-A231227 ..... N91-21442 #
AD-A231230 ..... N91-22061 #
AD-A231243 ..... N91-21867 #
AD-A231244 ..... N91-21923 #
AD-A231247 ..... N91-21681 #
AD-A231248 ..... N91-21285 #
AD-A231249 ..... N91-21793 #
AD-A231250 ..... N91-21721 #
AD-A231258 ..... N91-21760 #
AD-A231259 ..... N91-21120 #
AD-A231260 ..... N91-21142 #
AD-A231263 ..... N91-21478 #
AD-A231264 ..... N91-21924 #
AD-A231265 ..... N91-21548 #
AD-A231273 ..... N91-21794 #
AD-A231275 ..... N91-21858 #
AD-A231276 ..... N91-21761 #
AD-A231282 ..... N91-21762 #
AD-A231285 ..... N91-21479 #
AD-A231286 ..... N91-21480 #
AD-A231289 ..... N91-21709 #
AD-A231290 ..... N91-21763 #
AD-A231293 ..... N91-21321 #
AD-A231311 ..... N91-21764 #
AD-A231315 ..... N91-21549 #
AD-A231317 ..... N91-21839 #
AD-A231318 ..... N91-21417 #
AD-A231320 ..... N91-21443 #
AD-A231324 ..... N91-21550 #
AD-A231327 ..... N91-21925 #
AD-A231338 ..... N91-21926 #
AD-A231339 ..... N91-21322 #
AD-A231340 ..... N91-21329 #
AD-A231342 ..... N91-21481 #
AD-A231343 ..... N91-21482 #
AD-A231346 ..... N91-21868 #
AD-A231348 ..... N91-21927 #
AD-A231349 ..... N91-21928 #
AD-A231350 ..... N91-21301 #
AD-A231351 ..... N91-21589 #
AD-A231353 ..... N91-21143 #
AD-A231355 ..... N91-21710 #
AD-A231359 ..... N91-21722 #
AD-A231366 ..... N91-21878 #
AD-A231372 ..... N91-21765 #
AD-A231373 ..... N91-21658 #
AD-A231377 ..... N91-21682 #
AD-A231383 ..... N91-21392 #
AD-A231386 ..... N91-21483 #
AD-A231405 ..... N91-21766 #
AD-A231406 ..... N91-21767 #
AD-A231438 ..... N91-21929 #
AD-A231461 ..... N91-21393 #
AD-A231464 ..... N91-21930 #
AD-A231465 ..... N91-21974 #
AD-A231482 ..... N91-21241 #
AD-A231492 ..... N91-21551 #
AD-A231495 ..... N91-21418 #
AD-A231497 ..... N91-21419 #
AD-A231499 ..... N91-21840 #
AD-A231501 ..... N91-21330 #
AD-A231553 ..... N91-21931 #
AD-A231555 ..... N91-21323 #
AD-A231558 ..... N91-21723 #
AD-A231560 ..... N91-21227 #
AD-A231567 ..... N91-21683 #
AD-A231568 ..... N91-21932 #
AD-A231583 ..... N91-21420 #
AD-A231584 ..... N91-21768 #
AD-A231585 ..... N91-21228 #
AD-A231586 ..... N91-21444 #

AD-A231588 ..... N91-21153 #
AD-A231589 ..... N91-21421 #
AD-A231592 ..... N91-21624 #
AD-A231596 ..... N91-21659 #
AD-A231597 ..... N91-21422 #
AD-A231598 ..... N91-21660 #
AD-A231599 ..... N91-21423 #
AD-A231601 ..... N91-21684 #
AD-A231604 ..... N91-21445 #
AD-A231605 ..... N91-21811 #
AD-A231606 ..... N91-21933 #
AD-A231607 ..... N91-21879 #
AD-A231612 ..... N91-21694 #
AD-A231620 ..... N91-21502 #
AD-A231621 ..... N91-21484 #
AD-A231628 ..... N91-21695 #
AD-A231633 ..... N91-21424 #
AD-A231636 ..... N91-21934 #
AD-A231637 ..... N91-21260 #
AD-A231638 ..... N91-21859 #
AD-A231639 ..... N91-21769 #

AD-E501352 ..... N91-21931 #

AECS/IB-4 ..... N91-21715 #

AEDC-TR-90-26 ..... N91-21142 #
AEDC-TR-90-29 ..... N91-21141 #
AEDC-TR-90-31 ..... N91-21408 #
AEDC-TR-90-35 ..... N91-21501 #

AESA-EN1-890 ..... N91-21628 #

AFHRL-CR-90-80 ..... N91-21776* #

AFHRL-TP-88-33 ..... N91-21711 #
AFHRL-TP-90-89 ..... N91-21555 #

AFIT/CI/CIA-90-128 ..... N91-21660 #
AFIT/CI/CIA-90-129 ..... N91-21768 #
AFIT/CI/CIA-90-131 ..... N91-21228 #
AFIT/CI/CIA-90-136 ..... N91-21420 #
AFIT/CI/CIA-90-145 ..... N91-21684 #
AFIT/CI/CIA-90-150 ..... N91-21423 #

AFIT/GA/ENY/90D-03 ..... N91-21256 #

AFIT/GAE/ENY/90D-2 ..... N91-21259 #
AFIT/GAE/ENY/90D-06 ..... N91-21588 #
AFIT/GAE/ENY/90D-07 ..... N91-21118 #
AFIT/GAE/ENY/90D-10 ..... N91-22058 #
AFIT/GAE/ENY/90D-14 ..... N91-21119 #
AFIT/GAE/ENY/90D-19 ..... N91-21257 #
AFIT/GAE/ENY/90D-23 ..... N91-21737 #
AFIT/GAE/ENY/90D-31 ..... N91-21258 #

AFIT/GCE/ENG/90D-07 ..... N91-21760 #

AFIT/GCS/ENG/90D-3 ..... N91-21754 #
AFIT/GCS/ENG/90D-01 ..... N91-21738 #
AFIT/GCS/ENG/90D-02 ..... N91-21752 #
AFIT/GCS/ENG/90D-06 ..... N91-21962 #
AFIT/GCS/ENG/90D-07 ..... N91-21753 #
AFIT/GCS/ENG/90D-08 ..... N91-21412 #
AFIT/GCS/ENG/90D-12 ..... N91-21755 #

AFIT/GE/ENG/90D-19 ..... N91-21429 #
AFIT/GE/ENG/90D-20 ..... N91-21524 #
AFIT/GE/ENG/90D-22 ..... N91-21428 #
AFIT/GE/ENG/90D-37 ..... N91-21401 #
AFIT/GE/ENG/90D-59 ..... N91-21410 #

AFOEHL-90-169CA00111KGA ..... N91-21717 #

AFOSR-90-1178TR ..... N91-21777 #
AFOSR-90-1220TR ..... N91-21756 #
AFOSR-90-1225TR ..... N91-21441 #
AFOSR-91-0027TR ..... N91-21879 #
AFOSR-91-0028TR ..... N91-21932 #
AFOSR-91-0034TR ..... N91-21859 #
AFOSR-91-0035TR ..... N91-21769 #
AFOSR-91-0039TR ..... N91-21934 #
AFOSR-91-0041TR ..... N91-21260 #

AFWL-89-052 ..... N91-21486 #

AGARD-AG-322 ..... N91-21720 #
AGARD-AG-326 ..... N91-21404 #

AGARD-AR-265 ..... N91-21156 #
AGARD-AR-268 ..... N91-21464 #

AGARDOGRAPH-160 ..... N91-21135* #

AI-M-1133 ..... N91-21766 #
AI-M-1259 ..... N91-21767 #
AI-M-1263 ..... N91-21500 #

AIAA-89-3519 ..... N91-21137* #
AIAA-90-2268 ..... N91-21116* #
AIAA-90-3121 ..... N91-21144* #
AIAA-91-0342 ..... N91-21115* #
AIAA-91-0970 ..... N91-21580* #

AL-TR-89-059 ..... N91-21852 #
AL-TR-90-028 ..... N91-21855 #
AL-TR-90-040 ..... N91-21482 #
AL-TR-90-043-PHASE-4 ..... N91-21481 #
AL-TR-90-060 ..... N91-21329 #

ANL/ACL-90/2 ..... N91-21266 #

AP-42-SUPPL-C-VOL-1 ..... N91-21630 #

ARI-RN-91-14 ..... N91-21722 #

ARO-22280.11-EL ..... N91-21921 #
ARO-22966.3-MS ..... N91-21318 #
ARO-23422.9-EL ..... N91-21153 #
ARO-23554.4-EL-A ..... N91-21438 #
ARO-23764.3-EG-F ..... N91-21478 #
ARO-23941.3-CH ..... N91-21319 #
ARO-24008.3-MS ..... N91-21924 #
ARO-24372.1-MA-SDI ..... N91-21759 #
ARO-24566.8-MS ..... N91-21281 #
ARO-24626.175-PH-UIR ..... N91-21874 #
ARO-24626.176-PH-UIR ..... N91-21522 #
ARO-24626.177-PH-UIR ..... N91-21411 #
ARO-24788.7-EG ..... N91-21120 #
ARO-24863.13-EL ..... N91-21757 #
ARO-24974.13-CH ..... N91-21476 #
ARO-25143.19-MS-A ..... N91-21298 #
ARO-25391.57-PN ..... N91-21875 #
ARO-25426.3-PH-A ..... N91-21877 #
ARO-25842.5-EL ..... N91-21439 #
ARO-26130.9-MS-A ..... N91-21320 #
ARO-26277.7-PH ..... N91-21499 #
ARO-26394.4-MA ..... N91-21809 #
ARO-26460.6-EL ..... N91-21876 #
ARO-26781.1-MA ..... N91-21806 #
ARO-27246.1-EG-SAH ..... N91-21548 #
ARO-27773.1-EL-S ..... N91-21821 #

AVSCOM-TR-90-A-005 ..... N91-21134* #
AVSCOM-TR-90-C-015 ..... N91-21531* #
AVSCOM-TR-90-C-022 ..... N91-21534* #
AVSCOM-TR-91-C-004 ..... N91-21243* #

AWS/TR-90/001 ..... N91-21683 #

BNL-41530-2ND-ED ..... N91-21725 #
BNL-43779 ..... N91-21916 #
BNL-45415 ..... N91-21513 #
BNL-45416 ..... N91-21873 #
BNL-45443 ..... N91-21515 #
BNL-45484 ..... N91-21293 #
BNL-45592 ..... N91-21296 #
BNL-45593 ..... N91-21295 #
BNL-45594 ..... N91-21294 #
BNL-45634 ..... N91-21271 #
BNL-45888 ..... N91-21835 #

BRDEC-TR-2498 ..... N91-21327 #

BRL-MR-3891 ..... N91-21330 #

BRL-TR-3183 ..... N91-21442 #
BRL-TR-3184 ..... N91-21854 #
BRL-TR-3188 ..... N91-21328 #
BRL-TR-3192 ..... N91-21484 #

BR115687 ..... N91-21460 #

CAL-1884 ..... N91-21728* #

CBPF-NF-015/89 ..... N91-22062 #

CCMS-91-03 ..... N91-21561* #
CCMS-91-06 ..... N91-21560* #

CERL-TR-M-91/12 ..... N91-21424 #

CLS-90-101 ..... N91-21879 #

CONF-881204 ..... N91-21715 #
CONF-900432-2 ..... N91-21916 #
CONF-900722-1 ..... N91-21291 #
CONF-900866-2 ..... N91-21315 #
CONF-900870-10 ..... N91-21914 #
CONF-901025-32 ..... N91-21884 #
CONF-901025-33 ..... N91-21883 #
CONF-901025-34 ..... N91-21885 #
CONF-901025-35 ..... N91-21886 #
CONF-901025-36 ..... N91-21882 #
CONF-901025-37 ..... N91-21897 #
CONF-901025-41 ..... N91-21888 #
CONF-901025-42 ..... N91-21887 #
CONF-901105-97 ..... N91-21554 #
CONF-901105-98 ..... N91-21915 #
CONF-901105-103 ..... N91-21310 #
CONF-901105-104 ..... N91-21304 #
CONF-901105-107 ..... N91-21313 #
CONF-901141-3 ..... N91-22055 #
CONF-901194-14 ..... N91-21586 #
CONF-901202-1 ..... N91-21835 #
CONF-901219-10 ..... N91-21902 #
CONF-901282-1 ..... N91-21655 #
CONF-910116-20 ..... N91-21861 #
CONF-910123-13 ..... N91-21498 #
CONF-910123-14 ..... N91-21503 #
CONF-910162-4 ..... N91-21311 #
CONF-910186-2 ..... N91-21274 #
CONF-910189-1 ..... N91-21751 #
CONF-910202-6 ..... N91-21288 #
CONF-910202-7 ..... N91-21251 #
CONF-910207-3 ..... N91-21773 #
CONF-910276-4 ..... N91-21965 #
CONF-910278-3 ..... N91-21278 #
CONF-910279-6 ..... N91-21391 #
CONF-910279-7 ..... N91-21303 #
CONF-910279-12 ..... N91-21505 #
CONF-910291-1 ..... N91-21312 #
CONF-910293-1 ..... N91-21275 #
CONF-910414-25 ..... N91-21750 #
CONF-910505-1 ..... N91-21864 #
CONF-910531-1 ..... N91-21802 #
CONF-910531-2 ..... N91-21583 #
CONF-910531-3 ..... N91-21804 #
CONF-910552-1 ..... N91-21292 #
CONF-910552-2 ..... N91-21293 #
CONF-910552-3 ..... N91-21296 #
CONF-910552-4 ..... N91-21294 #
CONF-910552-5 ..... N91-21295 #
CONF-910552-6 ..... N91-21271 #
CONF-910552-8 ..... N91-21912 #
CONF-910561-1 ..... N91-21582 #
CONF-910575-1 ..... N91-21637 #
CONF-910595-1 ..... N91-21510 #
CONF-910595-2 ..... N91-21509 #
CONF-910595-3 ..... N91-21511 #
CONF-910595-4 ..... N91-21512 #
CONF-910595-5 ..... N91-21513 #
CONF-910595-6 ..... N91-21873 #
CONF-910598-1 ..... N91-21497 #
CONF-9006242-5-VUGRAPHS ..... N91-21514 #
CONF-9006242-6 ..... N91-21515 #
CONF-9007149-6 ..... N91-21289 #
CONF-9008184 ..... N91-21846 #
CONF-9008196-1 ..... N91-21906 #
CONF-9009123-66 ..... N91-21848 #
CONF-9009166-20 ..... N91-21508 #
CONF-9009230-2 ..... N91-21449 #
CONF-9009266-11 ..... N91-21488 #
CONF-9009269-8 ..... N91-21903 #
CONF-9009303-1 ..... N91-21267 #
CONF-9009339-2 ..... N91-21844 #
CONF-9009347-1 ..... N91-21273 #
CONF-9009351-1 ..... N91-21462 #
CONF-9010212-41 ..... N91-21436 #
CONF-9010254-2 ..... N91-21280 #
CONF-9010267-3 ..... N91-21865 #
CONF-9011127-17 ..... N91-21903 #
CONF-9011149-13 ..... N91-21740 #
CONF-9011149-14 ..... N91-21516 #
CONF-9011149-15 ..... N91-21808 #
CONF-9011155-2 ..... N91-21504 #
CONF-9103132-1 ..... N91-21841 #
CONF-9103135-1 ..... N91-21276 #
CONF-9104109-2 ..... N91-21656 #
CONF-9104190-1 ..... N91-21402 #
CONF-9104192-1 ..... N91-21265 #
CONF-9104194-1 ..... N91-21585 #
CONF-9104195-1 ..... N91-21535 #
CONF-9105112-1 ..... N91-21803 #
CONF-9105122-1 ..... N91-21407 #
CONF-9105125-1 ..... N91-21748 #
CONF-9105127-1 ..... N91-21872 #
CONF-9105129-1 ..... N91-21968 #
CONF-9105135-1 ..... N91-21749 #

CRIE-W-89052 ..... N91-21866 #

CRREL-90-11 ..... N91-21418 #

CSL-90-4 ..... N91-21425 #

CU-CSSC-91-4 ..... N91-21730* #
CU-CSSC-91-5 ..... N91-21731* #

CU-CSSC-91-6 ..... N91-21729* #

DC-126 ..... N91-21793 #

DE91-004503 ..... N91-21802 #
DE91-004542 ..... N91-21637 #
DE91-005059 ..... N91-21509 #
DE91-005061 ..... N91-21497 #
DE91-005236 ..... N91-21510 #
DE91-005312 ..... N91-21292 #
DE91-005459 ..... N91-21882 #
DE91-005474 ..... N91-21897 #
DE91-005488 ..... N91-21883 #
DE91-005489 ..... N91-21884 #
DE91-005490 ..... N91-21885 #
DE91-005491 ..... N91-21886 #
DE91-005542 ..... N91-21293 #
DE91-006002 ..... N91-21803 #
DE91-006089 ..... N91-21582 #
DE91-006379 ..... N91-21864 #
DE91-006565 ..... N91-21449 #
DE91-006915 ..... N91-21294 #
DE91-006916 ..... N91-21295 #
DE91-006917 ..... N91-21271 #
DE91-006918 ..... N91-21296 #
DE91-006967 ..... N91-21912 #
DE91-007128 ..... N91-21407 #
DE91-007328 ..... N91-21748 #
DE91-007346 ..... N91-21511 #
DE91-007571 ..... N91-21872 #
DE91-007697 ..... N91-21968 #
DE91-007923 ..... N91-21264 #
DE91-007932 ..... N91-21905 #
DE91-008042 ..... N91-21461 #
DE91-008072 ..... N91-21964 #
DE91-008124 ..... N91-21825 #
DE91-008131 ..... N91-21861 #
DE91-008171 ..... N91-21749 #
DE91-008173 ..... N91-21391 #
DE91-008180 ..... N91-21303 #
DE91-008198 ..... N91-21512 #
DE91-008252 ..... N91-21583 #
DE91-008286 ..... N91-21686 #
DE91-008366 ..... N91-21402 #
DE91-008367 ..... N91-21325 #
DE91-008405 ..... N91-21272 #
DE91-008413 ..... N91-21513 #
DE91-008423 ..... N91-21584 #
DE91-008439 ..... N91-21873 #
DE91-008443 ..... N91-21638 #
DE91-008446 ..... N91-21273 #
DE91-008453 ..... N91-21498 #
DE91-008500 ..... N91-21312 #
DE91-008505 ..... N91-21554 #
DE91-008506 ..... N91-21915 #
DE91-008509 ..... N91-21698 #
DE91-008569 ..... N91-21274 #
DE91-008574 ..... N91-21804 #
DE91-008582 ..... N91-21841 #
DE91-008585 ..... N91-21275 #
DE91-008587 ..... N91-21865 #
DE91-008593 ..... N91-21462 #
DE91-008595 ..... N91-21288 #
DE91-008605 ..... N91-21585 #
DE91-008628 ..... N91-21898 #
DE91-008732 ..... N91-21488 #
DE91-008735 ..... N91-21503 #
DE91-008828 ..... N91-21310 #
DE91-008838 ..... N91-21702 #
DE91-008839 ..... N91-21703 #
DE91-008842 ..... N91-21639 #
DE91-008874 ..... N91-21289 #
DE91-008877 ..... N91-21265 #
DE91-008885 ..... N91-21278 #
DE91-008887 ..... N91-21304 #
DE91-008894 ..... N91-21172 #
DE91-008924 ..... N91-21887 #
DE91-008925 ..... N91-21888 #
DE91-008926 ..... N91-21279 #
DE91-008927 ..... N91-21906 #
DE91-008928 ..... N91-21913 #
DE91-008986 ..... N91-21266 #
DE91-008988 ..... N91-21535 #
DE91-008989 ..... N91-21276 #
DE91-008990 ..... N91-21504 #
DE91-008993 ..... N91-21842 #
DE91-008997 ..... N91-21812 #
DE91-008999 ..... N91-21813 #
DE91-009000 ..... N91-21818 #
DE91-009002 ..... N91-21814 #
DE91-009006 ..... N91-21536 #
DE91-009008 ..... N91-21815 #
DE91-009034 ..... N91-21843 #
DE91-009038 ..... N91-21773 #
DE91-009042 ..... N91-21313 #
DE91-009045 ..... N91-21816 #
DE91-009074 ..... N91-21586 #
DE91-009083 ..... N91-21297 #
DE91-009101 ..... N91-21314 #
DE91-009102 ..... N91-21305 #
DE91-009105 ..... N91-21311 #
DE91-009106 ..... N91-21251 #
DE91-009110 ..... N91-21634 #
DE91-009112 ..... N91-21907 #
DE91-009113 ..... N91-21290 #
DE91-009116 ..... N91-21267 #
DE91-009150 ..... N91-21514 #
DE91-009153 ..... N91-21277 #
DE91-009167 ..... N91-21280 #
DE91-009170 ..... N91-21750 #
DE91-009175 ..... N91-21740 #
DE91-009183 ..... N91-21564 #
DE91-009189 ..... N91-21505 #
DE91-009191 ..... N91-21965 #
DE91-009219 ..... N91-21819 #
DE91-009221 ..... N91-21805 #
DE91-009222 ..... N91-21774 #
DE91-009223 ..... N91-21826 #
DE91-009224 ..... N91-21565 #
DE91-009225 ..... N91-21506 #
DE91-009226 ..... N91-21507 #
DE91-009227 ..... N91-21862 #
DE91-009228 ..... N91-21817 #
DE91-009229 ..... N91-21226 #
DE91-009256 ..... N91-21914 #
DE91-009259 ..... N91-21889 #
DE91-009326 ..... N91-21844 #
DE91-009327 ..... N91-21508 #
DE91-009329 ..... N91-21291 #
DE91-009353 ..... N91-21315 #
DE91-009377 ..... N91-21899 #
DE91-009378 ..... N91-21900 #
DE91-009435 ..... N91-21835 #
DE91-009439 ..... N91-21515 #
DE91-009444 ..... N91-21725 #
DE91-009458 ..... N91-21655 #
DE91-009461 ..... N91-21848 #
DE91-009479 ..... N91-21902 #
DE91-009482 ..... N91-21903 #
DE91-009483 ..... N91-21516 #
DE91-009514 ..... N91-21849 #
DE91-009517 ..... N91-21850 #
DE91-009520 ..... N91-21316 #
DE91-009530 ..... N91-21901 #
DE91-009540 ..... N91-21517 #
DE91-009543 ..... N91-21851 #
DE91-009561 ..... N91-21751 #
DE91-009593 ..... N91-21474 #
DE91-009669 ..... N91-22055 #
DE91-009716 ..... N91-21518 #
DE91-009736 ..... N91-21656 #
DE91-009750 ..... N91-21808 #
DE91-009773 ..... N91-21436 #
DE91-009825 ..... N91-21916 #
DE91-615879 ..... N91-21715 #
DE91-616827 ..... N91-22062 #
DE91-619576 ..... N91-21935 #
DE91-619585 ..... N91-21798 #
DE91-619625 ..... N91-21936 #
DE91-619626 ..... N91-21937 #
DE91-619627 ..... N91-21822 #
DE91-619752 ..... N91-21908 #
DE91-619859 ..... N91-21909 #
DE91-619982 ..... N91-21890 #
DE91-620399 ..... N91-21845 #
DE91-621717 ..... N91-21846 #
DE91-752966 ..... N91-21622 #
DE91-752990 ..... N91-21546 #
DE91-752995 ..... N91-21976 #
DE91-752996 ..... N91-21705 #
DE91-759126 ..... N91-21868 #

DIGEL-1990-5 ..... N91-21431 #
DIGEL-1990-6 ..... N91-21863 #

DLR-FB-89-39 ..... N91-21268 #
DLR-FB-89-43 ..... N91-21823 #
DLR-FB-89-45 ..... N91-21699 #
DLR-FB-89-50 ..... N91-21490 #
DLR-FB-89-63 ..... N91-21405 #
DLR-FB-90-01 ..... N91-21566 #
DLR-FB-90-20 ..... N91-21938 #
DLR-FB-90-31 ..... N91-21601 #
DLR-FB-90-34 ..... N91-21123 #
DLR-FB-90-37 ..... N91-21466 #
DLR-FB-90-39 ..... N91-21181 #
DLR-FB-90-40 ..... N91-21130 #
DLR-FB-90-41 ..... N91-21108 #
DLR-FB-90-42 ..... N91-21152 #

DLR-MITT-90-14 ..... N91-21254 #

DOD/SW/DK-90/008R ..... N91-21734 #

DODA-AR-006-450 ..... N91-21326 #

DOE/EA-0492 ..... N91-21172 #

DOE/ER-13456/31 ..... N91-21850 #
DOE/ER-13597/T3 ..... N91-21461 #
DOE/ER-13708/T2 ..... N91-21517 #
DOE/ER-13969/T1 ..... N91-21698 #
DOE/ER-13971/7 ..... N91-21849 #
DOE/ER-14125/1 ..... N91-21277 #
DOE/ER-25061/9 ..... N91-21474 #
DOE/ER-40235/T6 ..... N91-21851 #
DOE/ER-40370/T3 ..... N91-21843 #
DOE/ER-40370/3 ..... N91-21842 #
DOE/ER-45194/6 ..... N91-21316 #
DOE/ER-45310/30 ..... N91-21905 #
DOE/ER-53276/3 ..... N91-21889 #
DOE/ER-53302/3 ..... N91-21901 #
DOE/ER-54088/1 ..... N91-21899 #
DOE/ER-60348/T2 ..... N91-21686 #
DOE/ER-60556/T2 ..... N91-21703 #
DOE/ER-60678/3 ..... N91-21702 #
DOE/ER-61014/1 ..... N91-21639 #

DOE/NASA/5266-2 ..... N91-21625* #
DOE/NASA/50162-5 ..... N91-21302* #

DOE/PC-89775/3 ..... N91-21272 #
DOE/PC-90044/1 ..... N91-21325 #

DOE/SF-18438/1 ..... N91-21900 #

DOT/FAA/AM-90/16 ..... N91-21708 #

DOT/FAA/AS-90-3 ..... N91-21158 #

DOT/FAA/CT-TN89/69 ..... N91-21833 #
DOT/FAA/CT-TN90/28 ..... N91-21238 #

DOT/FAA/CT-90/13 ..... N91-21122 #

DOT/FAA/NR-91/4 ..... N91-21671 #

DREO-TN-90-20 ..... N91-21413 #

DREO-1041 ..... N91-21443 #
DREO-1047 ..... N91-21763 #

DRES-SM-1348 ..... N91-21483 #

DTIC/TR-89/21-VOL-1 ..... N91-21971 #
DTIC/TR-89/21-VOL-2 ..... N91-21972 #
DTIC/TR-90/3-VOL-1 ..... N91-21971 #
DTIC/TR-90/3-VOL-2 ..... N91-21972 #
DTIC/TR-91-1-PT-1 ..... N91-21969 #

E-5176 ..... N91-21185* #
E-5296 ..... N91-21062* #
E-5602 ..... N91-21252* #
E-5664 ..... N91-21625* #
E-5689 ..... N91-21447* #
E-5690 ..... N91-21116* #
E-5722 ..... N91-21531* #
E-5835 ..... N91-21240* #
E-5895 ..... N91-21137* #
E-5907 ..... N91-21243* #
E-5913 ..... N91-21302* #
E-5916 ..... N91-21534* #
E-5941 ..... N91-21559* #
E-5963 ..... N91-21233* #
E-5984 ..... N91-21060* #
E-6000 ..... N91-21910* #
E-6002 ..... N91-21562* #
E-6025 ..... N91-21433* #
E-6029 ..... N91-21309* #
E-6031 ..... N91-21448* #
E-6042 ..... N91-21378* #
E-6050 ..... N91-21061* #
E-6053 ..... N91-21458* #
E-6057 ..... N91-21558* #
E-6064 ..... N91-21553* #
E-6070 ..... N91-21797* #
E-6081 ..... N91-21138* #
E-6100 ..... N91-21182* #
E-6107 ..... N91-21184* #
E-6113 ..... N91-21140* #
E-6149 ..... N91-21115* #

EPA/540/8-90/007 ..... N91-21985 #
EPA/600/3-90/083 ..... N91-21631 #
EPA/905/4-90/002 ..... N91-21629 #

ERIM-213325-3-F ..... N91-21502 #

ESA-BR-63 ..... N91-21975 #

ESA-SP-314 ..... N91-21986 #

ESA-TT-1198 ..... N91-21268 #
ESA-TT-1209 ..... N91-21823 #
ESA-TT-1210 ..... N91-21699 #
ESA-TT-1212 ..... N91-21490 #
ESA-TT-1215 ..... N91-21405 #
ESA-TT-1216 ..... N91-21566 #
ESA-TT-1219 ..... N91-21465 #

ESD-TR-90-154 ..... N91-21437 #

ESDU-90021 ..... N91-21253
ESDU-90030 ..... N91-21129
ESDU-90033 ..... N91-21390
ESDU-90034 ..... N91-21102
ESDU-90035 ..... N91-21537
ESDU-90036 ..... N91-21103

ESG-112 ..... N91-21508 #

ESL-TR-722780-1 ..... N91-21394* #
ESL-TR-723090-1 ..... N91-21417 #

ETL-R-152 ..... N91-21973 #
ETL-R-153 ..... N91-21623 #

ETN-91-98905 ..... N91-21159 #
ETN-91-98961 ..... N91-21244 #
ETN-91-98969 ..... N91-21268 #
ETN-91-98970 ..... N91-21823 #
ETN-91-98971 ..... N91-21699 #
ETN-91-98972 ..... N91-21490 #
ETN-91-98973 ..... N91-21405 #
ETN-91-98974 ..... N91-21566 #
ETN-91-98975 ..... N91-21465 #
ETN-91-98976 ..... N91-21975 #
ETN-91-98977 ..... N91-21986 #
ETN-91-98981 ..... N91-21830 #
ETN-91-98983 ..... N91-21151 #
ETN-91-98985 ..... N91-21173 #
ETN-91-98987 ..... N91-21831 #
ETN-91-98988 ..... N91-21832 #
ETN-91-98989 ..... N91-21104 #
ETN-91-98990 ..... N91-21105 #
ETN-91-98991 ..... N91-21237 #
ETN-91-98992 ..... N91-21106 #
ETN-91-98993 ..... N91-21107 #
ETN-91-98994 ..... N91-21799 #
ETN-91-98995 ..... N91-21174 #
ETN-91-98997 ..... N91-21487 #
ETN-91-99006 ..... N91-21460 #
ETN-91-99029 ..... N91-21938 #
ETN-91-99030 ..... N91-21601 #
ETN-91-99031 ..... N91-21123 #
ETN-91-99032 ..... N91-21466 #
ETN-91-99033 ..... N91-21181 #
ETN-91-99034 ..... N91-21152 #
ETN-91-99035 ..... N91-21130 #
ETN-91-99036 ..... N91-21108 #
ETN-91-99038 ..... N91-21254 #
ETN-91-99039 ..... N91-21467 #
ETN-91-99040 ..... N91-21468 #
ETN-91-99041 ..... N91-21567 #
ETN-91-99042 ..... N91-21109 #
ETN-91-99043 ..... N91-21568 #
ETN-91-99044 ..... N91-21569 #
ETN-91-99045 ..... N91-21469 #
ETN-91-99046 ..... N91-21570 #
ETN-91-99047 ..... N91-21110 #
ETN-91-99048 ..... N91-21269 #
ETN-91-99050 ..... N91-21431 #
ETN-91-99051 ..... N91-21863 #
ETN-91-99055 ..... N91-21145 #
ETN-91-99057 ..... N91-21146 #
ETN-91-99058 ..... N91-21147 #
ETN-91-99059 ..... N91-21148 #

E19-666-2 ..... N91-21489* #

FFA-TN-1989-41 ..... N91-21467 #
FFA-TN-1989-43 ..... N91-21468 #
FFA-TN-1990-22 ..... N91-21567 #
FFA-TN-1990-24-PT-2 ..... N91-21109 #
FFA-TN-1990-32 ..... N91-21568 #
FFA-TN-1990-33 ..... N91-21569 #
FFA-TN-1990-36 ..... N91-21469 #
FFA-TN-1990-41 ..... N91-21570 #
FFA-TN-1991-03 ..... N91-21110 #

FFI-90/4005-VOL-4 ..... N91-21145 #
FFI-90/4005-VOL-6 ..... N91-21146 #
FFI-90/4005-VOL-7 ..... N91-21147 #
FFI-90/4005-VOL-8 ..... N91-21148 #

FHWA/HPR/NM-89-04 ..... N91-21125 #

FNAL/C-90/250 ..... N91-21864 #
FNAL/C-91/38 ..... N91-21848 #
FNAL/C-91/53-A ..... N91-21655 #
FNAL/C-91/61-A ..... N91-22055 #

FOA-B-40384-4.5 ..... N91-21269 #

FR-21319-1 ..... N91-21234* #

FSGTR-SE-65 ..... N91-21632 #

FTD-ID(RS)T-0886-88 ..... N91-21229 #

FTI-9042-001-PHASE-1 ..... N91-21735 #

GA-A-20272 ..... N91-21888 #
GA-A-20277 ..... N91-21887 #

GAO/IMTEC-90-61 ..... N91-21820 #
GAO/IMTEC-90-79 ..... N91-21136 #

GAO/NSIAD-91-125 ..... N91-21187 #

GIT-91-2 ..... N91-21939* #

GL-SR-263 ..... N91-21624 #
GL-SR-265 ..... N91-21659 #

GL-TR-89-0306 ..... N91-21881 #
GL-TR-90-0171 ..... N91-21650 #
GL-TR-90-0223 ..... N91-21624 #
GL-TR-90-0233 ..... N91-21659 #

GLNPO-01/90 ..... N91-21629 #

GPO-30-598 ..... N91-21977 #

GRI-90/0039 ..... N91-21389 #
GRI-90/0209.1 ..... N91-21262 #

H-1582-REV ..... N91-21587* #
H-1602 ..... N91-21446* #
H-1695 ..... N91-21135* #

HDL-TM-90-20 ..... N91-21933 #
HDL-TM-90-21 ..... N91-21869 #
HDL-TM-90-23 ..... N91-21400 #

HUGHES/EDSG-R160153 ..... N91-21430* #

IAE-4810-11 ..... N91-21909 #

IAEA-CN-53/A-1-2 ..... N91-21897 #
IAEA-CN-53/A-3-4 ..... N91-21885 #
IAEA-CN-53/A-4-1 ..... N91-21883 #
IAEA-CN-53/A-5-3 ..... N91-21884 #
IAEA-CN-53/A-6-3 ..... N91-21882 #
IAEA-CN-53/E-2-1-1 ..... N91-21886 #

IBM-RR-RJ7794 ..... N91-21926 #
IBM-RR-RJ7874 ..... N91-21322 #

ICASE-16 ..... N91-21139* #
ICASE-91-12 ..... N91-21724* #
ICASE-91-15 ..... N91-21796* #
ICASE-91-17 ..... N91-21453* #
ICASE-91-20 ..... N91-21457* #
ICASE-91-21 ..... N91-21455* #
ICASE-91-22 ..... N91-21454* #
ICASE-91-23 ..... N91-21451* #
ICASE-91-26 ..... N91-21456* #
ICASE-91-30 ..... N91-21099* #
ICASE-91-31 ..... N91-21801* #
ICASE-91-33 ..... N91-21800* #

IDA-P-2447 ..... N91-21931 #

IDA/HQ-90-35764 ..... N91-21931 #

IITRI-E06628-1 ..... N91-21419 #

INP-1458/PL ..... N91-21890 #
INP-1475/PH ..... N91-21845 #
INP-1477/PH ..... N91-21798 #
INP-1482/PH ..... N91-21935 #

INPE-4740-PRE/1415 ..... N91-21652 #
INPE-5075-PRE/1594 ..... N91-21620 #
INPE-5090-MD/44 ..... N91-21847 #
INPE-5120-RPE/627 ..... N91-21613 #
INPE-5124-RPE/629 ..... N91-21743 #
INPE-5125-RPE/630 ..... N91-21619 #
INPE-5127-RPE/632 ..... N91-21896 #
INPE-5136-PRE/1624 ..... N91-21608 #
INPE-5140-PRE/1628 ..... N91-22064 #
INPE-5143-PRE/1631 ..... N91-22054 #
INPE-5151-TDL/424 ..... N91-21742 #
INPE-5152-RPE/634 ..... N91-21747 #
INPE-5154-TDL/425 ..... N91-21967 #
INPE-5157-PRE/1636 ..... N91-21170 #
INPE-5158-PRE/1637 ..... N91-21169 #
INPE-5159-PRE/1638 ..... N91-21218 #
INPE-5160-RPE/635 ..... N91-21745 #
INPE-5161-RPE/639 ..... N91-21895 #
INPE-5165-TDL/426 ..... N91-21406 #
INPE-5166-RPE/637 ..... N91-21746 #
INPE-5170-PRE/1639 ..... N91-21615 #
INPE-5171-PRE/1640 ..... N91-21616 #
INPE-5172-PRE/1641 ..... N91-21617 #
INPE-5173-PRE/1642 ..... N91-21636 #
INPE-5174-PRE/1643 ..... N91-21607 #
INPE-5176-PRE/1645 ..... N91-21618 #
INPE-5177-PRE/1646 ..... N91-21606 #
INPE-5178-PRE/1647 ..... N91-21610 #
INPE-5179-PRE/1648 ..... N91-21614 #
INPE-5180-PRE/1649 ..... N91-21609 #
INPE-5184-PRE/1652 ..... N91-21604 #
INPE-5186-PRE/1654 ..... N91-21219 #
INPE-5187-PRE/1655 ..... N91-21605 #
INPE-5188-PRE/1656 ..... N91-21217 #
INPE-5192-PRE/1660 ..... N91-21171 #
INPE-5196-MD/45 ..... N91-21807 #
INPE-5198-TDL/427 ..... N91-21432 #
INPE-5200-RPE/639 ..... N91-21611 #
INPE-5202-PRE/1664 ..... N91-21603 #
INPE-5203-PRE/1665 ..... N91-21216 #
INPE-5204-PRE/1666 ..... N91-21602 #
INPE-5206-PRE/1668 ..... N91-21215 #
INPE-5207-PRE/1669 ..... N91-22060 #
INPE-5208-TDL/429 ..... N91-21672 #
INPE-5212-MD/46 ..... N91-21612 #
INPE-5213-RPE/641 ..... N91-21651 #
INPE-5216-PRE/1672 ..... N91-21126 #
INPE-5217-RPE/642 ..... N91-21744 #

INT-PATENT-CLASS-B01F-3/02 ..... N91-21496*
INT-PATENT-CLASS-B24G-1/00 ..... N91-21222*
INT-PATENT-CLASS-B25B-11/00 ..... N91-21545*
INT-PATENT-CLASS-B25G-3/00 ..... N91-21221*

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INT-PATENT-CLASS-G01N-31/12 ..... N91-21157*
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INT-PATENT-CLASS-G01S-13/89 ..... N91-21621*
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INT-PATENT-CLASS-G02B-6/16 ..... N91-21871*
INT-PATENT-CLASS-G02B-21/26 ..... N91-21545*
INT-PATENT-CLASS-G02B-21/32 ..... N91-21545*

INT-PATENT-CLASS-H01L-27/14 ..... N91-21434*
INT-PATENT-CLASS-H01S-3/22 ..... N91-21270*
INT-PATENT-CLASS-H02K-7/09 ..... N91-21824*
INT-PATENT-CLASS-H02K-41/00 ..... N91-21539*
INT-PATENT-CLASS-H05B-33/14 ..... N91-21911*

IS-T-1449 ..... N91-21279 #

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ISBN-951-8928-37-1 ..... N91-21705 #

ISL-CO-203/90 ..... N91-21830 #
ISL-CO-209/90 ..... N91-21151 #
ISL-CO-240/89 ..... N91-21173 #

ISL-R-110/90 ..... N91-21174 #
ISL-R-119/89 ..... N91-21831 #
ISL-R-120/89 ..... N91-21832 #
ISL-R-122/89 ..... N91-21104 #
ISL-R-123/89 ..... N91-21105 #
ISL-R-124/89 ..... N91-21237 #
ISL-R-125/89 ..... N91-21106 #
ISL-R-126/89 ..... N91-21107 #
ISL-R-127/89 ..... N91-21799 #

ISSN-0038-0911 ..... N91-22059 #
ISSN-0141-397X N91-21102
ISSN-0141-397X N91-21129
ISSN-0141-402X N91-21390
ISSN-0141-4054 ..... N91-21537
ISSN-0141-4097 ..... N91-21253
ISSN-0143-2702 ..... N91-21103
ISSN-0171-1342 ..... N91-21108 #
ISSN-0171-1342 ..... N91-21123 #
ISSN-0171-1342 ..... N91-21130 #
ISSN-0171-1342 ..... N91-21152 #
ISSN-0171-1342 ..... N91-21181 #
ISSN-0171-1342 ..... N91-21466 #
ISSN-0171-1342 ..... N91-21601 #
ISSN-0171-1342 ..... N91-21938 #
ISSN-0176-7739 ..... N91-21254 #
ISSN-0208-5658 ..... N91-21571 #
ISSN-0281-0263 ..... N91-21269 #
ISSN-0289-260X ..... N91-21379 #
ISSN-0358-5085 ..... N91-21546 #
ISSN-0389-4010 ..... N91-21111 #
ISSN-0389-4010 ..... N91-21112 #
ISSN-0389-4010 ..... N91-21113 #
ISSN-0389-4010 ..... N91-21114 #
ISSN-0389-4010 ..... N91-21491 #
ISSN-0389-4010 ..... N91-21538 #
ISSN-0547-5570 ..... N91-21399 #
ISSN-0782-7415 ..... N91-21705 #
ISSN-0782-9221 ..... N91-21976 #
ISSN-0785-4501 ..... N91-21622 #
ISSN-0802-2437 ..... N91-21145 #
ISSN-0802-2437 ..... N91-21146 #
ISSN-0802-2437 ..... N91-21147 #
ISSN-0802-2437 ..... N91-21148 #
ISSN-0915-633X ..... N91-21891 #
ISSN-0915-633X ..... N91-21892 #
ISSN-0915-633X ..... N91-21893 #
ISSN-0915-633X ..... N91-21894 #
ISSN-0958-0360 ..... N91-21253

ISVR-TR-189 ..... N91-21487 #

IVO-A-01/90 ..... N91-21705 #

IVO-B-03/90 ..... N91-21976 #

JA-6282 ..... N91-21437 #

JPL-D-8051 ..... N91-21264 #

JPL-PUBL-90-30 ..... N91-21331* #

KBQ-FR-2 ..... N91-21307* #

KCP-613-4380 ..... N91-21535 #

KHK-10 ..... N91-21530* #

L-16784 ..... N91-21059* #
L-16807 ..... N91-21127* #
L-16852 ..... N91-21556* #
L-16883 ..... N91-21860* #

LA-UR-91-468 ..... N91-21841 #
LA-UR-91-510 ..... N91-21275 #
LA-UR-91-532 ..... N91-21865 #
LA-UR-91-589 ..... N91-21462 #
LA-UR-91-610 ..... N91-21288 #
LA-UR-91-678 ..... N91-21585 #

LA-11781-MS ..... N91-21812 #
LA-11825-MS ..... N91-21817 #
LA-11829-MS ..... N91-21818 #
LA-11830-MS ..... N91-21816 #
LA-11847-MS ..... N91-21226 #
LA-11859-MS ..... N91-21813 #
LA-11919-MS ..... N91-21814 #
LA-12013-MS ..... N91-21819 #
LA-12029 ..... N91-21862 #

LBL-28685 ..... N91-21291 #
LBL-29614 ..... N91-21586 #
LBL-29843 ..... N91-21907 #
LBL-29883 ..... N91-21913 #
LBL-29888 ..... N91-21906 #
LBL-29924 ..... N91-21297 #
LBL-29957 ..... N91-21508 #
LBL-29960 ..... N91-21290 #
LBL-30110 ..... N91-21968 #
LBL-30129 ..... N91-21844 #
LBL-30222 ..... N91-21436 #

LC-79-640375 ..... N91-22059 #
LC-90-27785 ..... N91-21697 #
LC-90-71055 ..... N91-21399 #

LIYF-1518 ..... N91-21908 #

LUNDD/TMAT-90/2002 ..... N91-21269 #

L623-FY91-M020 ..... N91-21230* #

MIT/LCS/TM-438 ..... N91-21775 #

MPL-TM-417 ..... N91-21692 #
MPL-TM-418 ..... N91-21414 #
MPL-TM-419 ..... N91-21415 #

MPL-U-2/91 ..... N91-21694 #
MPL-U-6/90 ..... N91-21692 #
MPL-U-7/90 ..... N91-21414 #
MPL-U-8/90 ..... N91-21415 #
MPL-U-46/91 ..... N91-21678 #

MTL-TR-90-54 ..... N91-21300 #

MTR-10989 ..... N91-21416 #

NADC-90065-60 ..... N91-21709 #
NADC-90069-60 ..... N91-21719* #
NADC-90088-60 ..... N91-21707 #

NAL-SP-13 ..... N91-21379 #

NAL-TR-1059 ..... N91-21111 #
NAL-TR-1071 ..... N91-21112 #
NAL-TR-1072 ..... N91-21113 #
NAL-TR-1074 ..... N91-21538 #
NAL-TR-1075-T ..... N91-21114 #
NAL-TR-1078 ..... N91-21491 #

NAMRL-1356 ..... N91-21128 #

NAS 1.15:4216 ..... N91-21446* #
NAS 1.15:4256-VOL-2 ..... N91-21590* #
NAS 1.15:4260 ..... N91-21661* #
NAS 1.15:4261-PT-1 ..... N91-21662* #
NAS 1.15:4261-PT-2 ..... N91-21663* #
NAS 1.15:4262 ..... N91-21860* #
NAS 1.15:4270 ..... N91-21704* #
NAS 1.15:100065 ..... N91-21470* #
NAS 1.15:100772 ..... N91-21223* #
NAS 1.15:100773 ..... N91-21224* #
NAS 1.15:101667 ..... N91-21225* #
NAS 1.15:101709-REV ..... N91-21587* #
NAS 1.15:101739 ..... N91-21135* #
NAS 1.15:101801 ..... N91-22065* #
NAS 1.15:102175 ..... N91-21286* #
NAS 1.15:102178 ..... N91-21168* #
NAS 1.15:102420 ..... N91-21559* #
NAS 1.15:102624 ..... N91-21186* #
NAS 1.15:102669 ..... N91-21575* #
NAS 1.15:102758 ..... N91-21144* #
NAS 1.15:102776 ..... N91-21435* #
NAS 1.15:102778 ..... N91-21183* #
NAS 1.15:102780 ..... N91-21214* #
NAS 1.15:102830 ..... N91-21131* #
NAS 1.15:102879 ..... N91-21471* #
NAS 1.15:103258 ..... N91-21116* #
NAS 1.15:103276 ..... N91-21531* #
NAS 1.15:103342 ..... N91-21827* #
NAS 1.15:103384 ..... N91-21959* #
NAS 1.15:103399 ..... N91-21696* #
NAS 1.15:103424 ..... N91-21795* #
NAS 1.15:103527 ..... N91-21532* #
NAS 1.15:103528 ..... N91-21450* #
NAS 1.15:103529 ..... N91-21287* #
NAS 1.15:103530 ..... N91-21633* #
NAS 1.15:103649 ..... N91-21240* #
NAS 1.15:103678 ..... N91-21137* #
NAS 1.15:103688 ..... N91-21243* #
NAS 1.15:103694 ..... N91-21302* #
NAS 1.15:103695 ..... N91-21534* #
NAS 1.15:103729 ..... N91-21233* #
NAS 1.15:103742 ..... N91-21060* #
NAS 1.15:103749 ..... N91-21910* #
NAS 1.15:103750 ..... N91-21562* #
NAS 1.15:103763 ..... N91-21433* #
NAS 1.15:103767 ..... N91-21309* #
NAS 1.15:103769 ..... N91-21448* #
NAS 1.15:103775 ..... N91-21378* #
NAS 1.15:103779 ..... N91-21061* #
NAS 1.15:103780 ..... N91-21458* #
NAS 1.15:103782 ..... N91-21558* #
NAS 1.15:103787 ..... N91-21553* #
NAS 1.15:103791 ..... N91-21447* #
NAS 1.15:103793 ..... N91-21797* #
NAS 1.15:103817 ..... N91-21635* #
NAS 1.15:103833 ..... N91-21134* #
NAS 1.15:103844 ..... N91-22066* #
NAS 1.15:104031 ..... N91-21834* #
NAS 1.15:104033 ..... N91-21580* #
NAS 1.15:104045 ..... N91-21579* #
NAS 1.15:104046 ..... N91-21574* #
NAS 1.15:104047 ..... N91-21573* #
NAS 1.15:104048 ..... N91-21578* #
NAS 1.15:104050 ..... N91-21177* #
NAS 1.15:104052 ..... N91-21572* #
NAS 1.15:104053 ..... N91-21132* #
NAS 1.15:104065 ..... N91-21577* #
NAS 1.15:104066 ..... N91-21308* #
NAS 1.15:104067 ..... N91-21306* #
NAS 1.15:104334 ..... N91-21182* #
NAS 1.15:104338 ..... N91-21184* #
NAS 1.15:104340 ..... N91-21140* #
NAS 1.15:104359 ..... N91-21115* #
NAS 1.15:104539 ..... N91-21255* #
NAS 1.15:104541 ..... N91-21654* #
NAS 1.15:104542 ..... N91-21653* #
NAS 1.26:4337 ..... N91-21625* #
NAS 1.26:4352 ..... N91-21155* #
NAS 1.26:4355 ..... N91-21557* #
NAS 1.26:4361 ..... N91-21670* #
NAS 1.26:166044-VOL-1 ..... N91-21179* #
NAS 1.26:166044-VOL-2 ..... N91-21180* #
NAS 1.26:166482 ..... N91-21459* #
NAS 1.26:177372 ..... N91-21121* #
NAS 1.26:177522 ..... N91-21714* #
NAS 1.26:177565 ..... N91-21829* #
NAS 1.26:177571-VOL-1 ..... N91-21149* #
NAS 1.26:177571-VOL-2 ..... N91-21150* #
NAS 1.26:184091 ..... N91-21230* #
NAS 1.26:184099 ..... N91-21232* #
NAS 1.26:184101 ..... N91-21526* #
NAS 1.26:184104 ..... N91-21231* #
NAS 1.26:184137 ..... N91-22063* #
NAS 1.26:184141 ..... N91-21239* #
NAS 1.26:184846 ..... N91-21561* #
NAS 1.26:185239 ..... N91-21485* #
NAS 1.26:185261 ..... N91-21252* #
NAS 1.26:185642 ..... N91-21427* #
NAS 1.26:186271 ..... N91-21463* #
NAS 1.26:187079 ..... N91-21430* #
NAS 1.26:187082 ..... N91-21234* #
NAS 1.26:187089 ..... N91-21138* #
NAS 1.26:187097 ..... N91-21880* #
NAS 1.26:187104 ..... N91-21307* #
NAS 1.26:187510 ..... N91-21581* #
NAS 1.26:187514 ..... N91-21724* #
NAS 1.26:187517 ..... N91-21796* #
NAS 1.26:187519 ..... N91-21453* #
NAS 1.26:187529 ..... N91-21457* #
NAS 1.26:187530 ..... N91-21455* #
NAS 1.26:187531 ..... N91-21454* #
NAS 1.26:187532 ..... N91-21451* #
NAS 1.26:187535 ..... N91-21456* #
NAS 1.26:187538 ..... N91-21099* #
NAS 1.26:187539 ..... N91-21139* #
NAS 1.26:187541 ..... N91-21801* #
NAS 1.26:187543 ..... N91-21800* #
NAS 1.26:187736 ..... N91-21649* #
NAS 1.26:187806 ..... N91-21331* #
NAS 1.26:187891 ..... N91-21776* #
NAS 1.26:187935 ..... N91-21940* #
NAS 1.26:187936 ..... N91-21955* #
NAS 1.26:187988 ..... N91-21728* #
NAS 1.26:188014 ..... N91-21426* #
NAS 1.26:188018 ..... N91-21729* #
NAS 1.26:188025 ..... N91-21640* #
NAS 1.26:188026 ..... N91-21527* #
NAS 1.26:188027 ..... N91-21528* #
NAS 1.26:188028 ..... N91-21529* #
NAS 1.26:188030 ..... N91-21560* #
NAS 1.26:188032 ..... N91-21664* #
NAS 1.26:188034 ..... N91-21770* #
NAS 1.26:188045 ..... N91-21530* #
NAS 1.26:188048 ..... N91-21452* #
NAS 1.26:188049 ..... N91-21733* #
NAS 1.26:188053 ..... N91-21665* #
NAS 1.26:188058 ..... N91-21394* #
NAS 1.26:188062 ..... N91-21648* #
NAS 1.26:188075 ..... N91-21719* #
NAS 1.26:188079 ..... N91-21101* #
NAS 1.26:188082 ..... N91-21235* #

NAS 1.26:188083 ..... N91-21100* #
NAS 1.26:188084 ..... N91-21939* #
NAS 1.26:188087 ..... N91-21966* #
NAS 1.26:188089 ..... N91-21403* #
NAS 1.26:188090 ..... N91-21741* #
NAS 1.26:188091 ..... N91-21791* #
NAS 1.26:188092 ..... N91-21790* #
NAS 1.26:188093 ..... N91-21789* #
NAS 1.26:188094 ..... N91-21236* #
NAS 1.26:188096 ..... N91-22057* #
NAS 1.26:188099 ..... N91-22056* #
NAS 1.26:188101 ..... N91-21489* #
NAS 1.26:188102 ..... N91-21213* #
NAS 1.26:188146 ..... N91-22053* #
NAS 1.26:188148 ..... N91-21492* #
NAS 1.26:188153 ..... N91-21117* #
NAS 1.26:188154 ..... N91-21576* #
NAS 1.26:188162 ..... N91-21673* #
NAS 1.26:188177 ..... N91-21739* #
NAS 1.55:3078 ..... N91-21062* #
NAS 1.55:10061-VOL-1 ..... N91-21778* #
NAS 1.55:10062 ..... N91-21641* #
NAS 1.55:10066-PT-1 ..... N91-21188* #
NAS 1.55:10066-PT-2 ..... N91-21203* #
NAS 1.60:3040 ..... N91-21828* #
NAS 1.60:3077 ..... N91-21127* #
NAS 1.60:3078 ..... N91-21185* #
NAS 1.60:3084 ..... N91-21556* #
NAS 1.60:3085 ..... N91-21059* #
NAS 1.60:3108 ..... N91-21242* #
NAS 1.71:GSC-13220-1 ..... N91-21525* #

NASA-CASE-GSC-13220-1 ..... N91-21525* #

NASA-CASE-KSC-11395-1-CU N91-21473*

NASA-CASE-LAR-13580-1 ..... N91-21541*
NASA-CASE-LAR-13785-1 ..... N91-21824*
NASA-CASE-LAR-13952-2-SB N91-21472*
NASA-CASE-LAR-13981-1 ..... N91-21539*
NASA-CASE-LAR-14149-1-SB N91-21176*
NASA-CASE-LAR-14155-2-SB N91-21270*
NASA-CASE-LAR-14181-1 ..... N91-21911*

NASA-CASE-LEW-14776-1 ..... N91-21540*
NASA-CASE-LEW-14795-1 ..... N91-21871*

NASA-CASE-MFS-28177-1 ..... N91-21496*
NASA-CASE-MFS-28376-1 ..... N91-21175*
NASA-CASE-MFS-28420-1 ..... N91-21545*

NASA-CASE-MSC-20797-2 ..... N91-21494*
NASA-CASE-MSC-21059-3 ..... N91-21495*
NASA-CASE-MSC-21293-1 ..... N91-21700*
NASA-CASE-MSC-21361-1 ..... N91-21701*
NASA-CASE-MSC-21470-1 ..... N91-21157*
NASA-CASE-MSC-21476-1 ..... N91-21542*
NASA-CASE-MSC-21500-1 ..... N91-21493*
NASA-CASE-MSC-21502-1 ..... N91-21543*
NASA-CASE-MSC-21504-1 ..... N91-21221*
NASA-CASE-MSC-21534-1 ..... N91-21222*

NASA-CASE-NPO-17426-1-CU N91-21434*
NASA-CASE-NPO-17801-1-CU N91-21544*
NASA-CASE-NPO-17937-1-CU N91-21621*

NASA-CP-3078 ..... N91-21062* #
NASA-CP-10045 ..... N91-21062* #
NASA-CP-10061-VOL-1 ..... N91-21778* #
NASA-CP-10062 ..... N91-21641* #
NASA-CP-10066-PT-1 ..... N91-21188* #
NASA-CP-10066-PT-2 ..... N91-21203* #

NASA-CR-4337 ..... N91-21625* #
NASA-CR-4352 ..... N91-21155* #
NASA-CR-4355 ..... N91-21557* #
NASA-CR-4361 ..... N91-21670* #
NASA-CR-166044-VOL-1 ..... N91-21179* #
NASA-CR-166044-VOL-2 ..... N91-21180* #
NASA-CR-166482 ..... N91-21459* #
NASA-CR-177372 ..... N91-21121* #
NASA-CR-177522 ..... N91-21714* #
NASA-CR-177565 ..... N91-21829* #
NASA-CR-177571-VOL-1 ..... N91-21149* #
NASA-CR-177571-VOL-2 ..... N91-21150* #
NASA-CR-184091 ..... N91-21230* #
NASA-CR-184099 ..... N91-21232* #
NASA-CR-184101 ..... N91-21526* #
NASA-CR-184104 ..... N91-21231* #
NASA-CR-184137 ..... N91-22063* #
NASA-CR-184141 ..... N91-21239* #
NASA-CR-184846 ..... N91-21561* #
NASA-CR-185239 ..... N91-21485* #
NASA-CR-185261 ..... N91-21252* #
NASA-CR-185642 ..... N91-21427* #
NASA-CR-186271 ..... N91-21463* #
NASA-CR-187079 ..... N91-21430* #
NASA-CR-187082 ..... N91-21234* #
NASA-CR-187089 ..... N91-21138* #
NASA-CR-187097 ..... N91-21880* #
NASA-CR-187104 ..... N91-21307* #
NASA-CR-187510 ..... N91-21581* #
NASA-CR-187514 ..... N91-21724* #
NASA-CR-187517 ..... N91-21796* #
NASA-CR-187519 ..... N91-21453* #
NASA-CR-187529 ..... N91-21457* #
NASA-CR-187530 ..... N91-21455* #
NASA-CR-187531 ..... N91-21454* #
NASA-CR-187532 ..... N91-21451* #
NASA-CR-187535 ..... N91-21456* #
NASA-CR-187538 ..... N91-21099* #
NASA-CR-187539 ..... N91-21139* #
NASA-CR-187541 ..... N91-21801* #
NASA-CR-187543 ..... N91-21800* #
NASA-CR-187736 ..... N91-21649* #
NASA-CR-187806 ..... N91-21331* #
NASA-CR-187891 ..... N91-21776* #
NASA-CR-187935 ..... N91-21940* #
NASA-CR-187936 ..... N91-21955* #
NASA-CR-187988 ..... N91-21728* #
NASA-CR-188014 ..... N91-21426* #
NASA-CR-188018 ..... N91-21729* #
NASA-CR-188025 ..... N91-21640* #
NASA-CR-188026 ..... N91-21527* #
NASA-CR-188027 ..... N91-21528* #
NASA-CR-188028 ..... N91-21529* #
NASA-CR-188030 ..... N91-21560* #
NASA-CR-188032 ..... N91-21664* #
NASA-CR-188034 ..... N91-21770* #
NASA-CR-188045 ..... N91-21530* #
NASA-CR-188048 ..... N91-21452* #
NASA-CR-188049 ..... N91-21733* #
NASA-CR-188053 ..... N91-21665* #
NASA-CR-188058 ..... N91-21394* #
NASA-CR-188062 ..... N91-21648* #
NASA-CR-188075 ..... N91-21719* #
NASA-CR-188079 ..... N91-21101* #
NASA-CR-188082 ..... N91-21235* #
NASA-CR-188083 ..... N91-21100* #
NASA-CR-188084 ..... N91-21939* #
NASA-CR-188087 ..... N91-21966* #
NASA-CR-188089 ..... N91-21403* #
NASA-CR-188090 ..... N91-21741* #
NASA-CR-188091 ..... N91-21791* #
NASA-CR-188092 ..... N91-21790* #
NASA-CR-188093 ..... N91-21789* #
NASA-CR-188094 ..... N91-21236* #
NASA-CR-188096 ..... N91-22057* #
NASA-CR-188099 ..... N91-22056* #
NASA-CR-188101 ..... N91-21489* #
NASA-CR-188102 ..... N91-21213* #
NASA-CR-188146 ..... N91-22053* #
NASA-CR-188148 ..... N91-21492* #
NASA-CR-188153 ..... N91-21117* #
NASA-CR-188154 ..... N91-21576* #
NASA-CR-188162 ..... N91-21673* #
NASA-CR-188177 ..... N91-21739* #

NASA-TM-4216 ..... N91-21446* #
NASA-TM-4256-VOL-2 ..... N91-21590* #
NASA-TM-4260 ..... N91-21661* #
NASA-TM-4261-PT-1 ..... N91-21662* #
NASA-TM-4261-PT-2 ..... N91-21663* #
NASA-TM-4262 ..... N91-21860* #
NASA-TM-4270 ..... N91-21704* #
NASA-TM-100065 ..... N91-21470* #
NASA-TM-100772 ..... N91-21223* #
NASA-TM-100773 ..... N91-21224* #
NASA-TM-101667 ..... N91-21225* #
NASA-TM-101709-REV ..... N91-21587* #
NASA-TM-101739 ..... N91-21135* #
NASA-TM-101801 ..... N91-22065* #
NASA-TM-102175 ..... N91-21286* #
NASA-TM-102178 ..... N91-21168* #
NASA-TM-102420 ..... N91-21559* #
NASA-TM-102624 ..... N91-21186* #
NASA-TM-102669 ..... N91-21575* #
NASA-TM-102758 ..... N91-21144* #
NASA-TM-102776 ..... N91-21435* #
NASA-TM-102778 ..... N91-21183* #
NASA-TM-102780 ..... N91-21214* #
NASA-TM-102830 ..... N91-21131* #
NASA-TM-102879 ..... N91-21471* #
NASA-TM-103258 ..... N91-21116* #
NASA-TM-103276 ..... N91-21531* #
NASA-TM-103342 ..... N91-21827* #
NASA-TM-103384 ..... N91-21959* #
NASA-TM-103399 ..... N91-21696* #
NASA-TM-103424 ..... N91-21795* #
NASA-TM-103527 ..... N91-21532* #
NASA-TM-103528 ..... N91-21450* #
NASA-TM-103529 ..... N91-21287* #
NASA-TM-103530 ..... N91-21633* #
NASA-TM-103649 ..... N91-21240* #
NASA-TM-103678 ..... N91-21137* #
NASA-TM-103688 ..... N91-21243* #
NASA-TM-103694 ..... N91-21302* #
NASA-TM-103695 ..... N91-21534* #
NASA-TM-103729 ..... N91-21233* #
NASA-TM-103742 ..... N91-21060* #
NASA-TM-103749 ..... N91-21910* #
NASA-TM-103750 ..... N91-21562* #
NASA-TM-103763 ..... N91-21433* #
NASA-TM-103767 ..... N91-21309* #
NASA-TM-103769 ..... N91-21448* #
NASA-TM-103775 ..... N91-21378* #
NASA-TM-103779 ..... N91-21061* #
NASA-TM-103780 ..... N91-21458* #
NASA-TM-103782 ..... N91-21558* #
NASA-TM-103787 ..... N91-21553* #
NASA-TM-103791 ..... N91-21447* #
NASA-TM-103793 ..... N91-21797* #
NASA-TM-103817 ..... N91-21635* #
NASA-TM-103833 ..... N91-21134* #
NASA-TM-103844 ..... N91-22066* #
NASA-TM-104031 ..... N91-21834* #
NASA-TM-104033 ..... N91-21580* #
NASA-TM-104045 ..... N91-21579* #
NASA-TM-104046 ..... N91-21574* #
NASA-TM-104047 ..... N91-21573* #
NASA-TM-104048 ..... N91-21578* #
NASA-TM-104050 ..... N91-21177* #
NASA-TM-104052 ..... N91-21572* #
NASA-TM-104053 ..... N91-21132* #
NASA-TM-104065 ..... N91-21577* #
NASA-TM-104066 ..... N91-21308* #
NASA-TM-104067 ..... N91-21306* #
NASA-TM-104334 ..... N91-21182* #
NASA-TM-104338 ..... N91-21184* #
NASA-TM-104340 ..... N91-21140* #
NASA-TM-104359 ..... N91-21115* #
NASA-TM-104539 ..... N91-21255* #
NASA-TM-104541 ..... N91-21654* #
NASA-TM-104542 ..... N91-21653* #

NASA-TP-3040 ..... N91-21828* #
NASA-TP-3077 ..... N91-21127* #
NASA-TP-3078 ..... N91-21185* #
NASA-TP-3084 ..... N91-21556* #
NASA-TP-3085 ..... N91-21059* #
NASA-TP-3108 ..... N91-21242* #

NATICK/TR-91/002 ..... N91-21721 #
NATICK/TR-91/010 ..... N91-21133 #

NBDL-90R004 ..... N91-21706 #

NCAR/TN-345+STR ..... N91-21669 #
NCAR/TN-354+STR ..... N91-21154 #

NCPA-LC-3-1989 ..... N91-21840 #

NEAR-TR-418 ..... N91-21120 #

NEPRF-PR-90-016-442 ..... N91-21677 #
NEPRF-PR-90-050-431 ..... N91-21676 #

NIAR-90-14 ..... N91-21563 #

NIFS-70 ..... N91-21891 #
NIFS-71 ..... N91-21892 #
NIFS-72 ..... N91-21893 #
NIFS-73 ..... N91-21894 #

NIIYAF-MGU-89-34-111 ..... N91-21936 #
NIIYAF-MGU-89-60-137 ..... N91-21937 #
NIIYAF-MGU-90-4-150 ..... N91-21822 #

NOAA-DR-ERL-AOML-18 ..... N91-21685 #

NOAA-TM-ERL-ARL-186 ..... N91-21667 #

NOAA-TM-ERL-CMDL-2 ..... N91-21626 #

NOAA-TM-ERL-WPL-189 ..... N91-21647 #

NOAA-TM-NWS-WR-209 ..... N91-21668 #

NOARL-PR-89-069-252 ..... N91-21689 #
NOARL-PR-90-019-240 ..... N91-21836 #
NOARL-PR-90-064-323 ..... N91-21695 #
NOARL-PR-90-066-431 ..... N91-21681 #
NOARL-PR-90-082-221 ..... N91-21837 #
NOARL-PR-90-084-221 ..... N91-21838 #

NOARL-TN-58 ..... N91-21690 #
NOARL-TN-61 ..... N91-21675 #
NOARL-TN-87 ..... N91-21691 #

NORSAR-CONTRIB-421 ..... N91-21970 #

NOSC/TD-1917 ..... N91-21409 #

NPS-MR-91-001 ..... N91-21679 #

NPS-OR-91-02 ..... N91-21811 #

NRL-MR-6740 ..... N91-21726 #
NRL-MR-6753 ..... N91-21519 #
NRL-MR-6756 ..... N91-21444 #
NRL-MR-6774 ..... N91-21868 #

NRL-9281 ..... N91-21421 #

NSC-REPT(90)2 ..... N91-21159 #

NTIA-90-265-VOL-1 ..... N91-21396 #
NTIA-90-265-VOL-2 ..... N91-21397 #
NTIA-90-267 ..... N91-21398 #
NTIA-90-269 ..... N91-21395 #

NUSC-TD-88-03 ..... N91-21688 #

NYSERDA-90-1 ..... N91-21324 #

OCS/MMS-90/0041 ..... N91-21961 #

ONERA-NT-1987-7 ..... N91-21465 #

ONR-TR-27 ..... N91-21926 #
ONR-TR-28 ..... N91-21322 #

ORD-48508 ..... N91-21285 #

ORNL/FTR-3867 ..... N91-21634 #

ORNL/TM-11744 ..... N91-21774 #
ORNL/TM-11768 ..... N91-21805 #

OUEL-1863/90 ..... N91-21244 #

OY/PSTL-RR-100 ..... N91-21622 #

PB90-215518 ..... N91-21600 #
PB91-100321 ..... N91-21712 #
PB91-100321 ..... N91-21713 #
PB91-100339 ..... N91-21712 #
PB91-100347 ..... N91-21713 #
PB91-111757 ..... N91-21425 #
PB91-113019 ..... N91-22059 #
PB91-115444 ..... N91-21154 #
PB91-115535 ..... N91-21685 #
PB91-118844 ..... N91-21563 #
PB91-119172 ..... N91-21324 #
PB91-119180 ..... N91-21632 #
PB91-119206 ..... N91-21398 #
PB91-120527 ..... N91-21984 #
PB91-123257 ..... N91-21399 #
PB91-123356 ..... N91-21960 #
PB91-123922 ..... N91-21961 #
PB91-125674 ..... N91-21985 #
PB91-125880 ..... N91-21629 #
PB91-125906 ..... N91-21630 #
PB91-127332 ..... N91-21734 #
PB91-127720 ..... N91-21631 #
PB91-127829 ..... N91-21666 #
PB91-127993 ..... N91-21262 #
PB91-129080 ..... N91-21647 #
PB91-129098 ..... N91-21667 #
PB91-129122 ..... N91-21626 #
PB91-129239 ..... N91-21668 #
PB91-129304 ..... N91-21669 #
PB91-129379 ..... N91-21125 #
PB91-129635 ..... N91-21395 #
PB91-129643 ..... N91-21396 #
PB91-129650 ..... N91-21397 #
PB91-130237 ..... N91-21389 #
PB91-130369 ..... N91-21628 #
PB91-132035 ..... N91-21627 #

PNL-SA-18545 ..... N91-21251 #
PNL-SA-18587 ..... N91-21313 #
PNL-SA-18622 ..... N91-21310 #
PNL-SA-18847 ..... N91-21267 #
PNL-SA-18908 ..... N91-21311 #

PUB-9799 ..... N91-21600 #

PUBL-910415-VOL-1 ..... N91-21231* #

RADC-TR-90-313 ..... N91-21922 #
RADC-TR-90-346 ..... N91-21440 #

RAE-TM-AERO-2197 ..... N91-21460 #

RDA-TR-0226129003-001 ..... N91-21263 #

REPT-53-4511-3393 ..... N91-21301 #
REPT-91-1 ..... N91-21581* #
REPT-91B00036 ..... N91-21661* #
REPT-91B00038-PT-2 ..... N91-21663* #
REPT-91B00055 ..... N91-21641* #
REPT-91B00060 ..... N91-21255* #
REPT-91B00079 ..... N91-21670* #
REPT-91E01682 ..... N91-21654* #
REPT-91E01726 ..... N91-21653* #
REPT-504 ..... N91-21917 #
REPT-387929 ..... N91-21719* #

RI/RD-91-118 ..... N91-21235* #

RIACS-TR-90-21 ..... N91-21764 #

RISC-90/43 ..... N91-21984 #

S-HRG-101-981 ..... N91-21977 #

S-624-VOL-1 ..... N91-21778* #
S-625 ..... N91-21286* #
S-628 ..... N91-21168* #

SAIC-90/1437 ..... N91-21792 #

SAND-89-1023 ..... N91-21314 #
SAND-89-2869C ..... N91-21914 #
SAND-90-0102 ..... N91-21564 #
SAND-90-0610 ..... N91-21536 #
SAND-90-1706C ..... N91-21773 #
SAND-90-1851C ..... N91-21280 #
SAND-90-2336C ..... N91-21802 #
SAND-90-2437C ..... N91-21750 #
SAND-90-2550C ..... N91-21749 #
SAND-90-2552 ..... N91-21507 #
SAND-90-2737 ..... N91-21565 #
SAND-90-2993 ..... N91-21964 #
SAND-90-2998C ..... N91-21510 #
SAND-90-3122 ..... N91-21506 #
SAND-90-3143C ..... N91-21292 #
SAND-90-7035 ..... N91-21305 #
SAND-90-8254 ..... N91-21825 #
SAND-91-0011C ..... N91-21912 #
SAND-91-0169 ..... N91-21826 #
SAND-91-0232C ..... N91-21872 #
SAND-91-0292C ..... N91-21303 #
SAND-91-0400C ..... N91-21583 #
SAND-91-0401C ..... N91-21804 #
SAND-91-0412C ..... N91-21512 #
SAND-91-0420C ..... N91-21391 #
SAND-91-0505C ..... N91-21505 #
SAND-91-0517C ..... N91-21965 #
SAND-92-0402C ..... N91-21740 #

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SIO-REF-90-28 ..... N91-21678 #

SLCET-TR-88-1-REV-4.1 ..... N91-21445 #

SR-1 ..... N91-21650 #

SRI-MP-90-022 ..... N91-21262 #

SSD-TR-90-46 ..... N91-21904 #
SSD-TR-90-51 ..... N91-21878 #
SSD-TR-90-52 ..... N91-21547 #

STI-TR-1254-1 ..... N91-21149* #
STI-TR-1254-2 ..... N91-21150* #

SU-SOL-90-16 ..... N91-21765 #

SU-TR-25 ..... N91-21809 #

SUDAAR-595 ..... N91-21526* #
SUDAAR-597 ..... N91-21529* #

TACOM-TR-13502 ..... N91-21533 #

TOR-0091(6561-04)-1 ..... N91-21178 #

TR-3 ..... N91-21261 #
TR-10 ..... N91-21918 #
TR-12 ..... N91-21920 #
TR-12 ..... N91-21928 #
TR-13 ..... N91-21919 #
TR-24 ..... N91-21321 #
TR-30 ..... N91-21521 #
TR-31 ..... N91-21283 #
TR-33 ..... N91-21870 #
TR-34 ..... N91-21923 #
TR-41 ..... N91-21925 #

TR-90-9 ..... N91-21474 #
TR-90-07 ..... N91-21549 #
TR-90-1177 ..... N91-21550 #
TR-91-2 ..... N91-21686 #
TR-91-05 ..... N91-21239* #
TR-91-1187 ..... N91-21770* #
TR-008 ..... N91-21856 #
TR-439 ..... N91-21810 #
TR-0089(4930-06)-1 ..... N91-21878 #
TR-0089(4945-03)-4 ..... N91-21547 #
TR-0090(5925-01)-2 ..... N91-21904 #
TR-2924 ..... N91-21422 #

TRP/NCHRP/SYN-165 ..... N91-21399 #

TR7020-041-90 ..... N91-21389 #

TWR-17546-VOL-3 ..... N91-21230* #
TWR-17549-VOL-1 ..... N91-21231* #

UCID-21868 ..... N91-21584 #

UCRL-ID-104094 ..... N91-21518 #
UCRL-ID-104566 ..... N91-21898 #
UCRL-ID-105300 ..... N91-21815 #

UCRL-JC-104229 ..... N91-21488 #
UCRL-JC-104394 ..... N91-21504 #
UCRL-JC-104591 ..... N91-21915 #
UCRL-JC-104984-R1 ..... N91-21902 #
UCRL-JC-105123 ..... N91-21516 #
UCRL-JC-105124 ..... N91-21903 #
UCRL-JC-105356 ..... N91-21497 #
UCRL-JC-105391 ..... N91-21498 #
UCRL-JC-105417 ..... N91-21273 #
UCRL-JC-105424 ..... N91-21509 #
UCRL-JC-105541 ..... N91-21511 #
UCRL-JC-105616 ..... N91-21808 #
UCRL-JC-105984 ..... N91-21407 #
UCRL-JC-106127 ..... N91-21554 #
UCRL-JC-106275 ..... N91-21503 #
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UCRL-JC-106511 ..... N91-21276 #
UCRL-JC-106518 ..... N91-21274 #
UCRL-JC-106520 ..... N91-21312 #

UCRL-MA-105607 ..... N91-21838 #

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UILU-ENG-90-2258 ..... N91-21793 #

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UMC-IE-6-0391 ..... N91-21733* #

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US-PATENT-APPL-SN-140185 ..... N91-21911*
US-PATENT-APPL-SN-203178 ..... N91-21472*
US-PATENT-APPL-SN-213559 ..... N91-21700*
US-PATENT-APPL-SN-278137 ..... N91-21701*
US-PATENT-APPL-SN-283092 ..... N91-21496*
US-PATENT-APPL-SN-298150 ..... N91-21270*
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US-PATENT-APPL-SN-361479 ..... N91-21175*
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US-PATENT-APPL-SN-381239 ..... N91-21157*
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US-PATENT-APPL-SN-405168 ..... N91-21824*
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US-PATENT-APPL-SN-458258 ..... N91-21493*
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US-PATENT-APPL-SN-636532 ..... N91-21525* #
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US-PATENT-CLASS-DIG.4 ..... N91-21543*

US-PATENT-CLASS-52-646 ..... N91-21221*
US-PATENT-CLASS-62-90 ..... N91-21473*
US-PATENT-CLASS-62-333 ..... N91-21473*
US-PATENT-CLASS-62-384 ..... N91-21473*
US-PATENT-CLASS-73-49.8 ..... N91-21175*

US-PATENT-CLASS-73-149 ..... N91-21493*
US-PATENT-CLASS-73-149 ..... N91-21495*
US-PATENT-CLASS-73-432.1 ..... N91-21472*
US-PATENT-CLASS-73-663 ..... N91-21176*
US-PATENT-CLASS-73-852 ..... N91-21540*
US-PATENT-CLASS-73-865.6 ..... N91-21157*
US-PATENT-CLASS-73-865.6 ..... N91-21176*
US-PATENT-CLASS-73-866.4 ..... N91-21176*
US-PATENT-CLASS-92-103F N91-21494*
US-PATENT-CLASS-92-103SD N91-21494*
US-PATENT-CLASS-165-20 ..... N91-21496*
US-PATENT-CLASS-165-86 ..... N91-21473*
US-PATENT-CLASS-165-96 ..... N91-21473*
US-PATENT-CLASS-165-104.14 ..... N91-21473*
US-PATENT-CLASS-210-396 ..... N91-21701*
US-PATENT-CLASS-236-44A N91-21496*
US-PATENT-CLASS-236-94 ..... N91-21496*
US-PATENT-CLASS-244-14 ..... N91-21222*
US-PATENT-CLASS-244-158R N91-21222*
US-PATENT-CLASS-248-181 ..... N91-21543*
US-PATENT-CLASS-248-593 ..... N91-21541*
US-PATENT-CLASS-248-604 ..... N91-21541*
US-PATENT-CLASS-248-650 ..... N91-21543*
US-PATENT-CLASS-248-677 ..... N91-21543*
US-PATENT-CLASS-250-227 ..... N91-21871*
US-PATENT-CLASS-254-101 ..... N91-21543*
US-PATENT-CLASS-269-21 ..... N91-21545*
US-PATENT-CLASS-310-90.5 ..... N91-21539*
US-PATENT-CLASS-310-90.5 ..... N91-21824*
US-PATENT-CLASS-313-502 ..... N91-21911*
US-PATENT-CLASS-313-503 ..... N91-21911*
US-PATENT-CLASS-313-506 ..... N91-21911*
US-PATENT-CLASS-318-135 ..... N91-21539*
US-PATENT-CLASS-318-561 ..... N91-21544*
US-PATENT-CLASS-318-568.16 ..... N91-21542*
US-PATENT-CLASS-318-568.20 ..... N91-21542*
US-PATENT-CLASS-318-568.21 ..... N91-21542*
US-PATENT-CLASS-318-628 ..... N91-21544*
US-PATENT-CLASS-318-646 ..... N91-21544*
US-PATENT-CLASS-318-648 ..... N91-21544*
US-PATENT-CLASS-342-26 ..... N91-21621*
US-PATENT-CLASS-342-52 ..... N91-21621*
US-PATENT-CLASS-342-357 ..... N91-21621*
US-PATENT-CLASS-350-96.29 ..... N91-21871*
US-PATENT-CLASS-350-529 ..... N91-21545*
US-PATENT-CLASS-356-345 ..... N91-21871*
US-PATENT-CLASS-357-15 ..... N91-21434*
US-PATENT-CLASS-357-30 ..... N91-21434*
US-PATENT-CLASS-357-67S N91-21434*
US-PATENT-CLASS-357-71S N91-21434*
US-PATENT-CLASS-364-478 ..... N91-21544*
US-PATENT-CLASS-364-513 ..... N91-21542*
US-PATENT-CLASS-364-513 ..... N91-21544*
US-PATENT-CLASS-372-59 ..... N91-21270*
US-PATENT-CLASS-374-8 ..... N91-21157*
US-PATENT-CLASS-403-131 ..... N91-21543*
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US-PATENT-CLASS-403-176 ..... N91-21221*
US-PATENT-CLASS-403-252 ..... N91-21221*
US-PATENT-CLASS-417-190 ..... N91-21496*
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US-PATENT-CLASS-435-292 ..... N91-21700*
US-PATENT-CLASS-435-311 ..... N91-21700*
US-PATENT-CLASS-435-311 ..... N91-21701*
US-PATENT-CLASS-435-312 ..... N91-21700*
US-PATENT-CLASS-435-315 ..... N91-21701*
US-PATENT-CLASS-435-316 ..... N91-21700*
US-PATENT-CLASS-435-316 ..... N91-21701*
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US-PATENT-CLASS-502-324 ..... N91-21270*
US-PATENT-CLASS-901-9 ..... N91-21544*
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US-PATENT-4,990,988 ..... N91-21434*
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UTCMSE-90-02 ..... N91-21298 #

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UTRC-927544 ..... N91-21858 #

VPI-E-83-37 ..... N91-21557* #
VPI-E-91-01 ..... N91-21561* #
VPI-E-91-03 ..... N91-21560* #

VTT-TIED-1187 ..... N91-21546 #

WES/CR/ITL-90-1 ..... N91-21974 #

WES/MP/ITL-90-6 ..... N91-21762 #

WL-TR-89-050 ..... N91-21858 #

WRDC-TR-90-2083 ..... N91-21143 #
WRDC-TR-90-3067-PHASE-1 ..... N91-21735 #
WRDC-TR-90-4113 ..... N91-21299 #
WRDC-TR-90-5026 ..... N91-21761 #

WSRL-GD-28/90 ..... N91-21326 #

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